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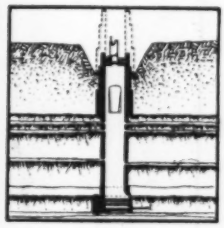
April 16, 1925

Engineering News-Record



Plugging a High-Pressure Service Tunnel

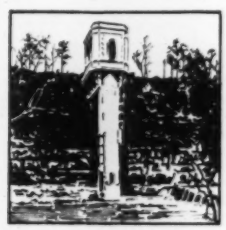
Difficult divers' work in tunnel 80 feet below ground was one of the essential operations of connecting new Buffalo, N.Y., filter plant to city's distribution system.

Garza Dam for Dallas Water-Works

Hydraulic-fill dam will store 63 billion gallons for the water supply of Dallas, Texas. Cost of project covered by a $5,000,000 bond issue voted during 1923.

Experience with Wood Grating in Filters

What Sacramento, Calif., can recommend from a year's comparison of wood-grating underdrains with perforated-pipe laterals for its two groups of rapid sand filters.



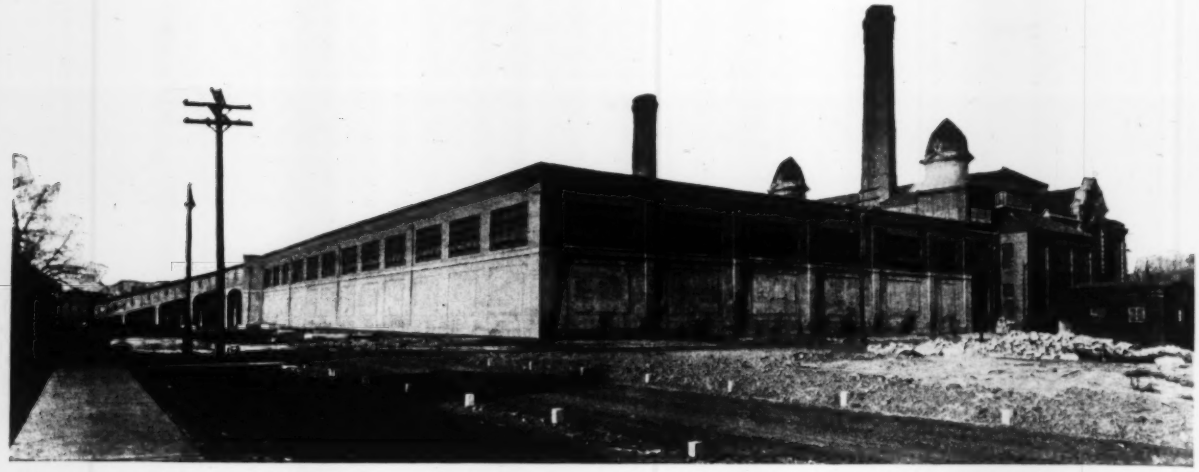
Dam Floods Danville Water-Works

Hydro-electric dam on Dix River inundated Kentucky city's pumping plant and filter. New pumping station must meet 70-foot variation in level of river.

Every-Day Water-Works Problems Solved

Twelve pages of short articles on construction, maintenance and operation of plants, and methods in treatment and filtration of supplies. These articles cover as many states as there are articles and represent primarily water-works practice in small municipalities.

WATER-WORKS NUMBER



Detroit Water Works, Detroit, Mich. Coal Storage roofed with Federal precast channel slabs

—*and for waterworks roofs* . . .

So general has the use of Federal Cement Tile become that every industry and every type of public building includes several important installations. It has found favor with officials everywhere for waterworks roofs.

The two photographs reproduced here show a characteristic waterworks installation. There are many such; some larger, some smaller, but all on waterworks structures where invariably it is immediately apparant that the effort throughout was to procure the best of materials.

Federal Cement Tile are made for all flat and pitched surfaces in four styles: Interlocking, Glass Insert, Channel and Flat Slabs. Strict supervision of manufacture in a modern daylight plant and the use of high-grade materials insure uniformity. Scientific design and proper steel reinforcement impart ample strength and durability. Made, laid and guaranteed by

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Interior view of Detroit Water Works Coal Storage. Note that Federal channel roof slabs also serve as the ceiling.

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ENGINEERING NEWS-RECORD

McGraw-Hill Company, Inc.
JAMES H. McGRAW, *President*
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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Small Town Water-works

THE articles selected in recognition of this year's annual convention of the American Water Works Association relate chiefly to the problems of water-works in what for convenience may be called "small towns." These problems are many, varied and interesting, and they require engineering ability of no small kind, especially in view of ofttimes limited financial resources and the frequent need of adapting improvements to a conglomeration of plant too costly to be discarded entire if even in part. This the articles attest.

Manual of Water-Works Practice

SINCE the American Water Works Association has got down to substantial work between conventions, its annual meetings have improved and the water-works fraternity is being better served. The Louisville convention, during the week beginning April 27, will visualize a large part of the efforts of its Standardization Council in bringing out a Manual of Water-Works Practice. Material is available for more than 600 pages representing 80 per cent of the text on the seventy-five topics which the Standardization Council outlined as necessary to treat. Not the last word has been said by the numerous workers on the various subjects, and on many of them changes will be brought out by discussions at the convention. If nothing else were on the program but discussions of these best-practice chapters of the manual, water-works operators would find the convention worth attending.

Industrial Co-operation

CAPITAL and labor got together in the first of the projected series of "Industrial Round Tables" in New York last week. The Secretary of Commerce, the president of the American Federation of Labor and the president of the General Electric Co. spoke, and these representatives of the public, labor and capital, respectively, voiced one sentiment—that co-operative effort must be made to reduce that greatest of national wastes, the once-called irrepressible conflict between employer and employed. This is no new sentiment; it has appeared from time to time ever since labor learned that it had rights and capital realized that it had responsibilities. But there were indications in this latest meeting that something real would be accomplished by these meetings. Mr. Hoover voiced this something in his introduction, when he made again his familiar plea for a self-correction of the ills of industry. Government, in the Secretary's philosophy, can do little to straighten out business ills, except to provide means for those who might correct those ills to come together. Co-operation is a hackneyed word, perhaps, but Mr. Hoover has made it live and workable, and he proposes here that its force should be applied to those industrial troubles which reach back to the wilfulness or selfishness of either of the two great elements in industry, capital and labor. And the remarks of both Mr. Green and Mr. Swope rang true. Neither seemed to be speaking for effect, as too often such leaders speak. They both know, and their words and manner showed it, that to forge ahead or even to keep the pace, American industry must recognize the mutuality of all of its interests and discuss, and settle, its problems on the basis of that mutuality. One meeting does not make a program or settle a problem, but this first one is promising of welcome results.

Legislative Road Maps

A LESSON to state legislatures on highway location practices is repeated again this year by Governor Smith of New York in passing on new legislation increasing the state road system by some 2,400 miles. Designating the bill as being "as near to a perfect plan as we can possibly get under our existing system" the Governor approves the act and says: "Laying out highway routes I do not believe to be a legislative function. It is an engineering problem and while it remains a legislative one we will never be able to resist the temptation to lay out new routes as the result of log-rolling projects in the legislature not strictly destined to improve the state highway system but rather to promote the interests of some localities." So rarely has a state chief executive visioned highway system location as clearly as has the governor of New York that his remarks stand out among the official utterances on highway administration of this very active year in road legislation.

Unprofitable Waterways

INLAND waterways advocates will find little consolation in the forthcoming report of the Board of Engineers for Rivers and Harbors on the proposed Lake Erie-Ohio River canal. Colonel Kutz, in a preliminary announcement extracted elsewhere in this issue, states that while all three of the proposed routes are feasible from an engineering point of view, they are not economically desirable, that on two of the routes the fixed charges would greatly exceed the prospective benefits and that the third route when *operated to capacity* would yield benefits approximately equal to the fixed charges with the present inequalities in competitive freight rates, but that with those inequalities removed, as it is reasonable to expect they will be, the third route also would be economically inadvisable. This cold drench of elemental fact will not be welcome to our waterways dreamers. They do not or will not understand that the cost of the long distance haul is a relatively small part of the cost of handling freight and that time and certainty of delivery have a much higher value than

they did in the days when canal and river traffic flourished in this country. They may not yet be convinced that these conditions are applicable to the canal which they have been advocating for years between the Ohio and Lake Erie, but it is fortunate that Congress, whenever it comes to consider appropriating money for this canal, will have definite figures placed before it.

Road Form Precision

FORMS for concrete road construction are being more precisely specified by highway engineers. This fact should be regarded well by contractors—it is the final fraction in precision that costs high in setting road forms. This fraction, too, is getting to be mighty small. In the last revision of the form specification of an important road-building state the allowable deviation in line and level of any 10-ft. section of form top is ⅛ in. And "the engineer may require the contractor to operate finishing machine and subgrader over forms prior to starting of construction that they may be inspected to determine whether the same will remain true to line and grade during construction." In brief it is required not only that forms shall be built to very precise line and grade but that they shall remain exact under the rather strenuous duty of being a track for finishers and subgraders. And in these same specifications the track rail may not have "been in use on more than ten miles of roadway on other projects." This limitation on the working life of forms needs also to be noted by the contractor in making his bids. In urging notice by contractors of the effect on costs of more exacting road form specifications no criticism is implied. If true road surfaces are essential then exact form setting and maintenance are required. As everywhere in construction, however, greater perfection brings greater costs and contractors cannot afford to overlook the fact.

Unexplored Conditions

SOMETHING of a mystery presents itself in the case of the Oklahoma oil tank failure, described on p. 638. A large tank ruptured and its contents burned, the fire spreading over a large area and threatening many other tanks but fortunately wrecking only one besides the tank of origin. Apparently the known facts as to the causation of the fire are that the contents of the first tank burned and that the tank ruptured, the two events occurring either simultaneously or one before the other—no one knows which. Thus the cause is a mystery. Commonly, mystery implies ignorance, and in the present case some of the elements essentially involved in the case are matters about which we know little. One of them is the effect of a large change of temperature occurring very suddenly, as happened in the period immediately preceding the accident. We know that a 60-deg. drop in temperature produces a deformation corresponding to a stress of 10,000 lb. per sq.in. and we can reason that if shell and bottom of tank differ in temperature by 60 deg. a set of forces corresponding to a tension of 10,000 lb. per sq.in. in a small ring along the base of the tank shell will have to be taken up somehow in the form of complex reactions between shell and base. But we do not know much about the resulting stresses. Apparently the stress conditions are not susceptible of analysis or other than the roughest kind of estimate. We may infer that ordinarily they are not critical, since no previous trouble due to differential expansion or shrinkage of this kind has been reported. But it is quite possible that they can become critical in some cases, and they may be large in all cases, at least large enough to warrant investigation. The mechanical condition of the tank again represents unusual and unexplored conditions: The combination of welding and riveting, especially the welded connection between base of shell and the curb angle around the tank bottom. Such welded connections, and more particularly combinations of welded and riveted construction, are relatively few, and experience with them is limited. It is not known how they will behave under all sets of conditions. Thus, it may be that the welded base connection was subjected to abnormal service by the tendency to distortion that arose from the temperature drop preceding the accident. The part played by such possible factors in the Ponca City tank failure is likely to remain obscure until experiment and experience improve our knowledge concerning the strength of steel tanks.

Lessons from Weeping Water and Chicago

PERHAPS the superintendent who deliberately wrecks a water-works filtration plant because he is lazy and competent, is less rare than the one who is energetic but incompetent. Into the former class, seems to fall the individual who ran the little plant at Weeping Water, Neb., described elsewhere in this issue. No one but a clever genius would think of rearranging the piping to reverse the direction of filtration, punch holes in the strainers to reduce the head, replace the sand by coarser material and consign the coagulant apparatus to the junk pile. To make these changes required effort, so he may have been more well-intentioned than an off-hand opinion would indicate in his endeavor to make the plant work without attention.

Before condemning people as indolent it should be remembered that the automatic shifting of steam engine valves was first done by a lazy boy who tired of doing it by hand. Perhaps the Weeping Water superintendent felt he had fallen on a boon to operators in his attempt to make an upward flow filter, one that would run continuously without washing; but such attempts, like revolutions, must be successful to be justified. Unfortunately for the Nebraska "inventor" his scheme was a failure, and some one happened along who saw that influent and effluent were equally turbid. The washing problem that irked the operator had been solved at the sacrifice of the main result, and the citizens had to pay for and consume the unsavory product.

As has been said so often in these columns, science—represented here by the filter plant—applied without knowledge too often gives the people a false sense of security. No doubt the local officials continually boasted of their filter plant as affording full protection from water-borne diseases.

In a large city, where so many lives are in jeopardy, competent operation under the watchful eye of the best scientific talent is even more essential than in a small one. Only last year Chicago learned boasting of the purity of its water supply at the intake cribs did not mean a safe supply at the tap. Passage of water through a leaky tunnel system beneath a city honey-

combed with underground conduits resulted in a bacterial content higher than that of the original lake water.

It is not the intention to intimate that the Weeping Water superintendent has a counterpart of incompetency in Chicago, but to point out that scientific investigators can and do find weak points in a system; weaknesses that come about from changing conditions. So long as Weeping Water got its supply from wells it was safe. Until Chicago, to meet the exorbitant demands of an unmetered consumption, got to pulling down the water levels at the pumping station ends of its lake tunnels and the areas surrounding the numerous land shafts became congested, the groundwater head of water surrounding the land shafts and tunnels was low and seepage was insignificant. Now the pollution is so serious that to counteract it as much as may be the limit of chlorine dosage of the water before it enters the cast-iron pressure system has nearly been reached. Long ago the chlorine taste limit was passed. So serious is the difficulty that for the first time filtration has been publicly advocated by John Ericson, city engineer.

Both Weeping Water, the town of a thousand, and Chicago, the city of three million, have had lessons as to the danger of incompetent supervision of a water filter and of lack of sanitary supervision and delay in providing filtration when changing conditions demand it. Such lessons may well be heeded not only by those cities but also by towns and cities small and large the country over.

What Is a Water-works Man

THE ten thousand water-works of the United States and Canada present a number and variety of problems in design, choice of material, construction, as well as in physical, chemical, bacterial, financial and other phases of operating control, that would make a surprising category if assembled. Put alongside this category an outline of the relationship of our water-works to manufacturing and other industrial processes, to the safety of homes, protection of offices, shops and factories against fire, to the comfort, convenience, health and life of some scores of millions of human beings and the exhibit would be still more surprising and significant. A hamlet too small to have a public water supply is handicapped by that lack and the watered town or city would be crippled in a few hours, decimated in a few days and depopulated in a few weeks if the water supply were cut off with no certainty of speedy restoration.

Who designs, builds and runs the water-works of the country? Many of the smaller ones, and even those of considerable size built in the earlier days, never were designed, as the term is and should be understood. They were built more or less haphazard, or if not they have been extended in that fashion. Today, a large percentage of even the small plants and plant extensions are put in the hands of more or less competent engineers and the percentage is increasing. For the larger works and major extensions most of our city fathers have recognized the necessity of engineering service, either temporary or permanent, from the start. Today, for water-works large and small, there are many more engineers engaged on water-works large and small, there are many more engineers engaged on water-works design and construction than in any other branch of municipal work. As for water-works construction, the works or extensions having been designed, the engineer is more and more in evidence.

Contractors and manufacturers have always played a large part in water-works design, either for entire plants or their important elements. This was particularly true for works in the earlier days, even in places of considerable size, and notably for pumps, filters and, in many of the smaller places, for pipe systems even if not for the entire plant. Much of this designing was well done, even though it did go far towards eliminating competition. In construction it was but natural and as a rule desirable that contractors should build original works and major extensions.

Once built, and taking numbers rather than size into account, by far the larger number of the water-works of the country have been and still are operated by men without engineering education or experience. Happily this, too, is rapidly changing, for whereas thirty years ago only a part of the large cities of the countries and a few progressive small ones employed engineers as superintendents and managers, today hundreds of cities and private companies do so, while numerous cities have a good-sized staff of civil and sanitary engineers regularly employed. With these may be mentioned the small army of chemists and bacteriologists that could be assembled from the water-works plants of the United States and Canada.

Since the advent of the city manager, the water-works of scores of smaller places have had the benefit of more engineering management than before, either from the managers who are engineers or because of the building up of better technical staffs under the city managers than existed under the old decentralized haphazard administration.

What is the job of the water-works man in building or operating works? First of all, he must see that a given city has water from a source that is safe and can be made safe by treatment carefully chosen to meet local conditions. He must see that the supply is always ample in volume and pressure, and above all free from danger of infection, which means safeguards in design, sound construction, never failing supervision, and swift emergency repairs. Whether it be the engineer or some other official, someone must look after a hundred wants and caprices of individual consumers. Someone must provide sound financial control. Essentially the job is an engineering job and as such it can best be done by an engineer, if not as chief administrator, in the larger places, then at least as bureau head.

But whether engineer or not, the waterworks man will be benefited by the contact he gets from membership in the waterworks associations. Constantly for half a century our two major associations have been contributing to the progress of water-works design, construction and operation. They deserve better support than they have received from the municipalities and private water companies of the United States and Canada. Even the larger of the associations has but 2,200 members—small when it is remembered that there are ten thousand or more water-works which should have from one to a hundred representatives in one or the other association. Those that belong and take active part can handle better their job as water-works men.

Garza Dam for Dallas Water-Works Will Impound 63 Billion Gallons

Hydraulic Fill Utilizing Floating Equipment Dredging in Sand, Gravel and Clay Layers Carefully Prospected—Puddle Core Trenches with Steel Sheetpiles—Double Set of Spillways

DALLAS, Tex., has now under construction a hydraulic-fill dam across the Elm Fork of Trinity River, near the town of Garza, 26 miles northwest of the city. A reservoir of 63 billion gallons capacity will be formed to store water for municipal purposes only. A bond issue of $5,000,000 was voted in April, 1923, for the construction of the project. The reservoir has a drainage area of a little more than 1,100 square miles over which the average annual rainfall is 35 in. Features of this work are the choice of site, decision to utilize a less favorable material near at hand, mixing of sand, gravel and clay or gumbo layers, after diligent prospecting by an elaborate system of borings, core trenches with a single row of steel sheetpiles encased in puddle, and two spillways, one of concrete for regular service and a second for emergency use in a low ridge.

The water-works system of Dallas, which now serves a population of 225,000, together with numerous manufacturing industries, has a total storage of about 7 billion gallons impounded in five reservoirs, the largest of which has a capacity of about 5.5 billion gallons. The Garza reservoir will make available about ten times the present storage and should serve from three to five times the present population, with allowance for in-

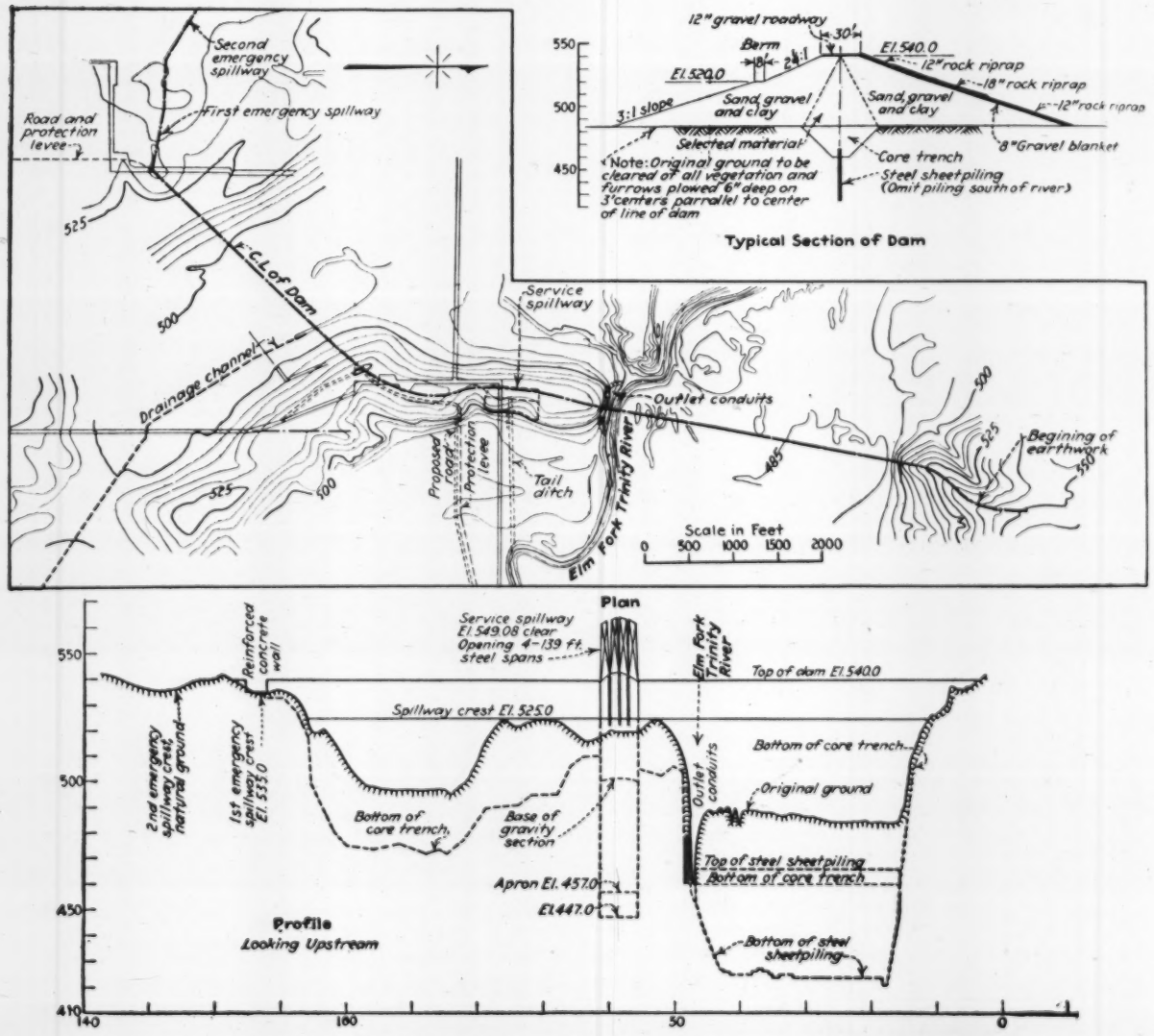


FIG. 1—GARZA RESERVOIR HYDRAULIC-FILL DAM, GENERAL PLAN AND PROFILE

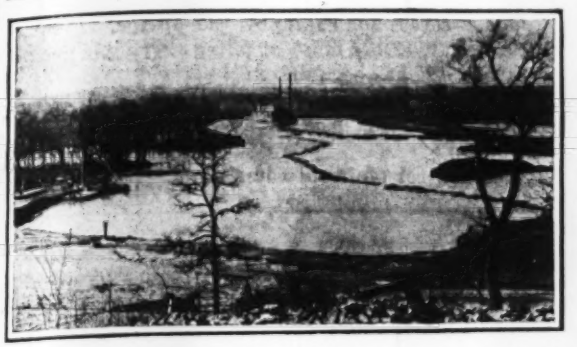


FIG. 2—THE 20-INCH SUCTION DREDGE CUTTING ITS WAY TO BETTER MATERIAL

Launching pit at extreme right. The nearest floating line is the waterproof electric cable.

creased consumption due to additional industries and normal increase in domestic per capita consumption.

The Garza dam site lies in the Woodbine beds of the Lower Cretaceous, which are composed of alternating irregular beds of sands, shale and sandstones. In general this formation, on account of its permeability, is not well adapted to the economic construction of dams and as a consequence the total cost of this dam in particular will be considerably greater than is ordinarily the case for more regularly stratified geological formations. However, the site selected was chosen after detailed examinations of eighteen other possible sites in the vicinity of Dallas as conforming, more nearly than any other site, to the prescribed specifications, which were that the reservoir must impound in excess of 50 billion gallons, and cost not to exceed the proceeds of the sale of the bond issue.

Preliminary drillings at the dam site disclosed a fairly uniform foundation of shale at reasonable depth to which core trenches could be excavated, and subsequently be filled with puddled clay or interlocking steel sheetpiling. The floor of the valley above the dam site is quite uniformly overlaid with an alluvial clay blanket from 5 to 20 ft. thick.

The clay blanket, however, overlies sand and gravel deposits of varying thickness which, it was decided, would form, with the clay, a mixture suitable for hydraulic filling and hence this class of dam embankment was prescribed. An electrically-operated suction dredge was installed, having a capacity of about 250,000 cu.yd. per month. The 20-in. dredge pump is directly connected to a 1,600-hp. 2,300-volt alternating-current motor and discharges through a 20-in. pipe on to the dam. A total of 2,000,000 cu.yd. of embankment will be placed by this dredge.

Material—A strip of ground lying upstream from the dam and adjoining the 300-ft. berm to be left at the upstream toe was investigated for a borrow pit for the hydraulic fill. This strip is about 2,000 ft. wide, parallel to the river channel, and is about 6,000 ft. long across the valley. The borings over this area were

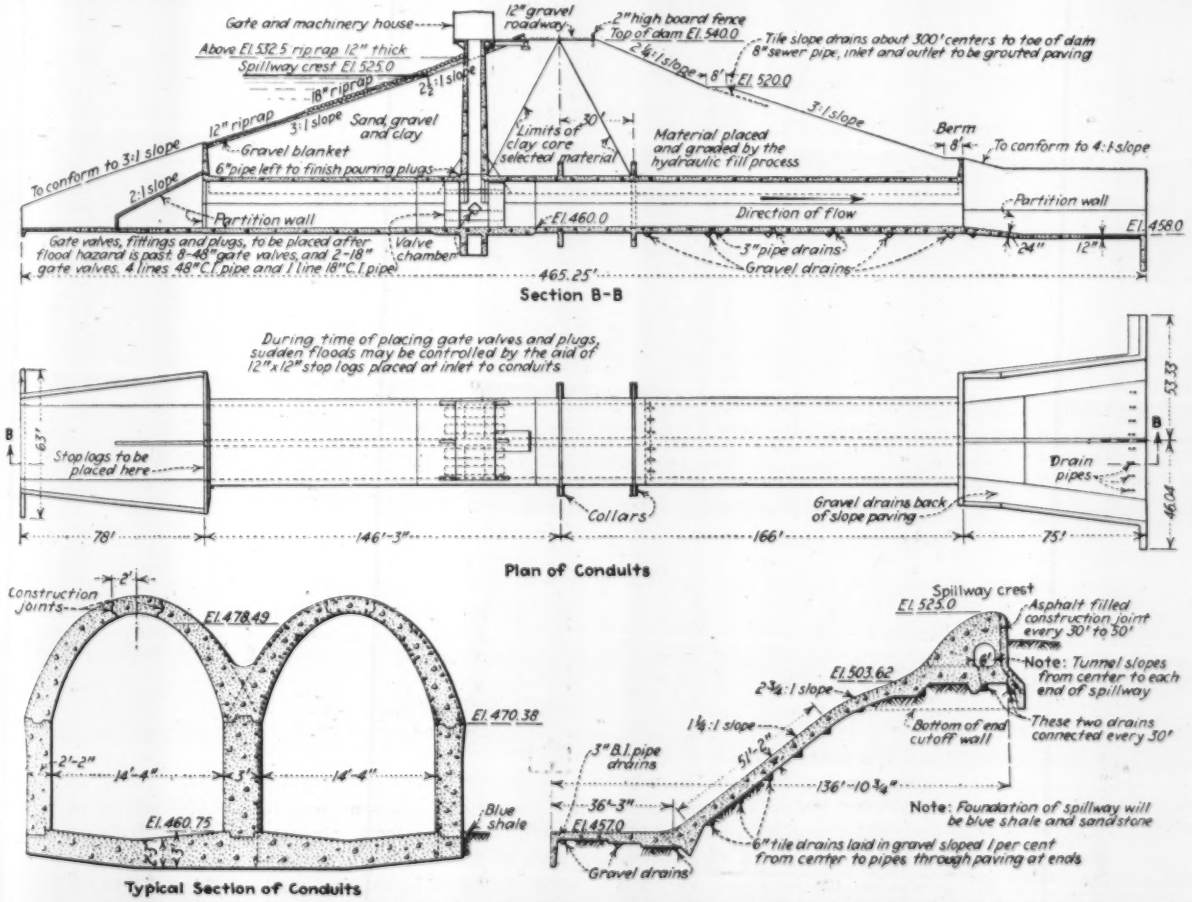


FIG. 3—CONDUITS FOR CONSTRUCTION OUTLETS AND FUTURE CONTROL, AND SECTION OF SERVICE SPILLWAY

made by hand with an 8-in. post-hole auger and the holes were spaced approximately 400 ft. each way. Where loose sand or gravel that would cave was struck the holes were cased with 6-in. pipe and cleaned out with a 4-in. sand bucket down to the shale or sandstone.

The investigation showed that of 9,000,000 cu.yd. of material available above the rock in this area more than half of it is undesirable for hydraulic-fill construction because it is clay containing only a small amount of very fine sand and no gravel. This large body of undesirable material is about in the middle of the valley along the river channel.

On each edge of the valley there is a considerable body of material overlying the rock from 15 to 25 ft. deep running from 25 per cent sand and gravel and 75 per cent gumbo and clay to 100 per cent sand and gravel. The most of this more favorable material is located on the south edge of the valley and is very similar to the material used for the storage dam at Wichita Falls (see *Engineering News-Record*, Dec. 20, 1923, p. 1004). There is enough of this latter material to build the entire dam but it would require an average pipe line length of about 4,000 ft. and a maximum of more than 6,000 ft. This length would require a booster and would otherwise restrict the output of the dredge and add to the cost.

The less favorable material can be placed on the dam with an average pipe line about 2,500 ft. long, and it seemed worth while to give this material a thorough trial. It usually runs from 2 to 5 ft. thick of black gumbo on top of a very tough brown clay underlaid by sand and gravel. This gumbo and clay is hard to cut but reaches the fill in balls ranging in size from ½ in. to 10 in. in diameter. Even where there is no gravel mixed with these balls they make a surprisingly compact fill. A man can walk over this fill to within a few feet of the core pool while it is being pumped in, but in order to get on to it to build up the outside levees with a crawler-tractor-operated dragline it is necessary to use mats, which is not the case with a gravel or sand fill.

All of this clay contains considerable very fine sand but the pumping has not proceeded far enough yet to say what percentage of it is going to be lost through the core pool. It is evident, however, that there will be considerable surplus core material if a large percentage of this clay and gumbo is used.

Embankment—The total length of the dam is two miles and the maximum height will be 80 ft. The upstream slope will be 3 to 1, and the downstream slope also 3 to 1, but modified to admit of two 8-ft. berms being placed 20 and 50 ft., respectively, below the top of the dam. A top width of 30 ft. will provide room for a graveled highway. A freeboard of 15 ft. is provided between the top of the dam and spillway crest. The upper slope will be protected throughout with 18 in. of limestone from Stringtown, Okla., hand laid on 8 in. of gravel.

Across the main valley of the river for a distance of 3,500 ft. a core trench, having a bottom width of 12 ft. with side slopes of 1 to 1 and varying from 25 to 30 ft. deep, has been excavated to ground-water level, in which a single line of interlocking steel sheetpiles weighing 35 lb. per square foot has been driven to the underlying shale. The piling extends up into the trench a minimum distance of 6 ft. and will be encased in the clay puddle core pumped in by the dredge. A total of 121,925 sq.ft. (2,134 tons) of piling varying in length from 14 to 45 ft. has been driven.

All core trenches were excavated with a dragline, electrically operated, having a 5-cu.yd. bucket and 100-ft. boom.

For the control of flood water during the construction period, concrete conduits are being installed in the river bank immediately south of the channel, of a total length of 465 ft., including inlet and outlet, and consisting of two oval-shaped barrels having a major (vertical) diameter of 19 ft. and minor (horizontal) diameter of 14 ft. These conduits will have a discharge capacity of 12,000 sec.-ft. under 44-ft. head, which will be sufficient to carry normal floods.

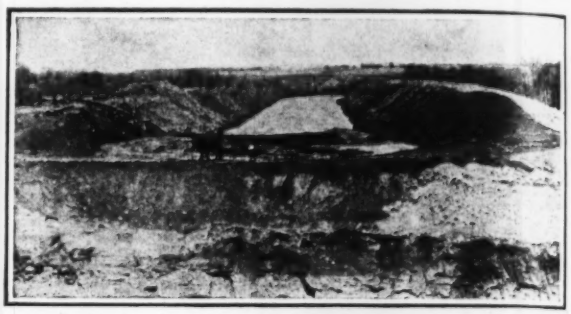


FIG. 4—BEGINNING THE HYDRAULIC FILL BETWEEN THE WALLS PLACED BY TEAMS
The embankment on each toe was placed from the core trench and conduit excavations and wet down.

After the dam is completed two 48-in. gate valves will be installed in each conduit barrel, and one 18-in. valve in one barrel to pass water from the reservoir through to the river channel below the dam and thence to the city settling basins and filter plant at Turtle Creek for municipal use. These valves will be hand operated from the gate house on top of the dam.

Spillway—On the high ground south of the river channel a concrete spillway 560 ft. long and of ogee gravity-type section will be built with crest at sea-level El. 525, or 15 ft. below the top of the dam. The main body of the spillway will vary in height from 15 ft. to 25 ft. and will rest on hard shale. It will be connected with an apron 68 ft. downstream by a concrete slab 4 ft. thick constructed on a slope 2¾ to 1 and increasing to 1½ to 1 at the apron floor. The apron will be at El. 457 and will be protected by a cutoff wall extending into shale 10 ft. below the floor level. The highway will be carried over the spillway on four 139-ft. steel spans.

At the extreme south end of the dam there are two low sections in the ridge through which flood water will be discharged in case of unusual and extraordinary floods. These will begin to discharge when the water is 10 ft. deep on the service spillway crest. For a depth of 10 ft. over the service spillway its discharge capacity will be 58,000 sec.-ft. and for a depth of 14 ft. the combined capacity of all spillways will be 135,000 sec.-ft.

Reservoir Basin—At service spillway level, El. 525, the reservoir will cover about 11,000 acres of land. It will have a length of nearly 11 miles, an average width of a little more than 1½ miles and a maximum width of about 1¾ miles. The miximum depth of water at spillway level will be 65 ft. in the original stream

bed only, and across the main valley will be 40 ft. The average depth over the whole basin will be about 18 ft. By using flash boards on the spillway crest it will be possible to increase the depth of water in the reservoir 2 ft. and its capacity to 70 billion gallons at such future date as increased storage may be required.

To provide for policing the reservoir, and for increasing the height of water during high water stages the city is purchasing lands adjacent to the reservoir basin up to sea level, El. 535, or 10 ft. above the spillway crest. In some instances additional acreage has been purchased in order to effect satisfactory settlement with land owners, of which there were about 130 in the basin. In a few instances condemnation proceedings were necessary in order to acquire title to the lands. The average price so far paid has been about $70 per acre. While the larger portion of the basin is cultivated farm lands, about two-fifths of the area (4,450 acres) has to be cleared of large timber, underbrush and sprouts on abandoned cultivated fields. The clearing work has been begun under contract.

One designated state highway crosses the reservoir basin about midway of its length. There are several minor roads which also cross the basin. It will be necessary to elevate about one mile of the track of one railroad (the Texas & Pacific, east of Denton) about 5 ft. The highways will be taken care of partly by

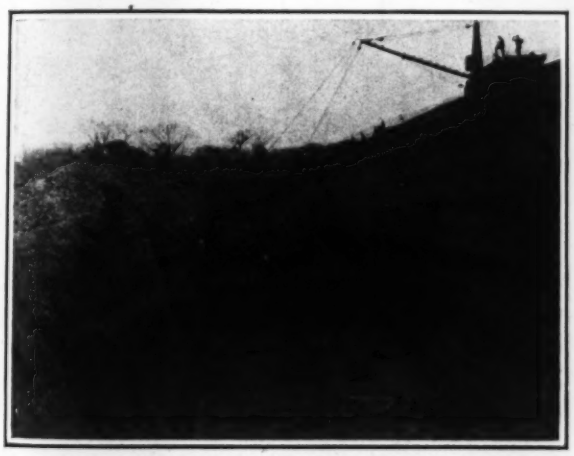


FIG. 5—POURING THE SIDE AND CENTER WALLS OF THE OUTLET CONDUITS

Floor has already been placed. The arched top will be the next operation. The conduit barrels end at the shoulders, cut in the shale where the depression extends across the floor.

connecting them up with the road across the dam at the lower end of the reservoir and partly by constructing an embankment across the basin about ten miles above the dam. This embankment will be 12 ft. high and will be surfaced with gravel. There will be a 100-ft. steel span across the stream channel and 1,150 ft. of creosoted-pile bridge opening additional. This valley crossing will be about 1½ miles in length. In addition to this and the 2 miles of road on the crest of the dam, 9 miles of new gravel-surfaced connecting highway must be built and 8 miles of existing roads surfaced with gravel. It will be necessary to take up 2 miles of existing 6-in. gas main located near the upper highway and to relay it so as to carry it across the embankment. About 30 miles of telephone lines within the basin will have to be taken out, and connecting lines constructed along both the upper and lower highways.

This project has been carried forward by the city administration, with J. C. Nagle and R. A. Thompson as engineers in charge, O. N. Floyd, principal assistant, J. L. Lochridge, designing engineer, and T. C. Shuler, resident engineer. The contract was awarded to the W. E. Callahan Construction Co. of Dallas, Tex., on Aug. 15, 1924. The Puget Sound Dredging Co. of Seattle, Wash., has the subcontract for the hydraulic fill.

Progress of St. Louis New Water Works on the Missouri

AT THE new water-works plant of St. Louis on the Missouri River is being undertaken what is probably the most extensive and elaborate scheme for controlling and directing the flow of a big river ever attempted in municipal water-works construction. For a distance of five miles of river the banks must be protected and the channel forced and kept within the lines best suited to serve the water-works. In high water, which is 35 ft. above low water, there must be waterway enough to prevent the river from cutting away the banks at any point or from making a detour across the low lands. In low water, according to E. E. Wall, water commissioner, the river must be confined to a straight and narrow path in front of the shore intake of the water-works. All this requires a system of pile dikes, 26 in number, ranging from 100 ft. to 2,500 ft. in length, requiring more than 600,000 lin.-ft. of piling, over 2,000,000 sq.ft. of woven willow mattress, and 60,000 cu.yd. of stone for sinking mattress and bank revetment. There will also be required interlocking concrete sheetpiling along several hundred feet of river front at the intake to prevent bank erosion.

This work was started in August, 1923, and the river channel has already been forced over toward the lines desired. In another year it will probably be where it has been planned for it to run. The cost will approach $750,000 and such is the uncertain behavior of the Missouri River that any year may necessitate spending large sums for changes and repairs.

Construction of the low-service engine pit has given rise to interesting problems. The rock is about 70 ft. below the mean stage of the river and the general land level is some 95 ft. above rock. Above rock almost all the material is sand. The actual area covered by the intake and engine pit is 12,000 sq.ft., its largest dimension being 130 ft., so that the cofferdam had to be of the cellular type. A dredge was floated into the enclosure before the last cells were driven so that the excavation could readily be made over the whole area. More than 500 reinforced-concrete foundation piles, 15 in. square and 48 ft. long, were driven in this pit to rock, their tops, when driven, being 30 ft. under water.

Work on the first 60-in. steel pump main has started. It will run across country through farms, across and along highways, through real estate subdivisions for 16 miles, from the Missouri River plant to the city. It is astonishing, says Mr. Wall, how valuable the land to be occupied by this pipe line has become. Within the space of a few months it has doubled, trebled and quadrupled in value.

Experience with Wood-Grating in Sacramento Filters

Delicate Hydraulic Equilibrium Requires Refined Calculations—Cemented Gravel Will Help if Strongly Made

By Harry N. Jenks
Superintendent, Pumping and Filtration Works, Sacramento, Calif.

JUDGING by the number of inquiries received from time to time, considerable interest is being shown in the experience with the wood-grating underdrains installed in the Sacramento filters. Lest the impression be gained that the difficulties encountered in this plant in the operation of the filters equipped with false bottoms might be interpreted too broadly to mean that this type of underdrain is unsatisfactory in general, the following notes may be of value to designers who are considering the use of wood-grating or slat-bottom underdrains for rapid sand filters. Because of the somewhat limited experience at Sacramento it is hardly advisable to make any generalized statements, except that in theory the introduction of wash-water through a false bottom is fundamentally sound, though in practice certain evident disadvantages present themselves, unless special care is taken to obviate them.

In the Sacramento plant four filters in the north group are equipped with wood-grating underdrains, while perforated pipe laterals are installed in the south group. Fig. 1 is a construction photograph showing a partly completed unit. The false bottom consists essentially of 3x6-in. joists laid transversely to the filter on 4-ft. centers, upon which are mounted 2x4-in. stringers separated by spacer blocks so that a clear opening of ⅞ in. between the stringers is obtained. All the lumber is surfaced on four sides. In the photograph one of the joists is seen beneath the nearest wash-water gutter. Each pair of joists forms a separate compartment, or clear waterway, under the stringers, approximately 4 ft. wide by 12 ft. long by 6 in. deep. Wash-water is admitted into each bay through four 5-in. cored holes from a central header channel built below the wash-water drain trough that divides each filter in half.

From the time these filters were placed in service in April, 1924, it was apparent that what might be termed an hydraulic instability characterized their operation in comparison with that of the perforated-pipe underdrains. In general, due to relatively low resistances, any inequality in static head throughout the system has a correspondingly greater effect in producing uneven washing of the filter, as compared with the performance of the perforated-pipe laterals. Therefore much more refined hydraulic calculations must be made in connection with the main distribution channel and ports through which the water is admitted under the false bottom. It has been found that as little as a 2-in. difference in water head along the main distribution channel, which is 58 ft. in length, may be responsible for noticeable inequalities in rates of wash.

In addition to this circumstance, and in the Sacramento case of even greater importance, the wood-grating underdrains were at the worst disadvantage because of the large amount of dissolved oxygen which, upon liberation from the water under negative head or otherwise, collected in the open spaces under the false bottom and from time to time escaped upward in a single mass. A most disruptive effect was produced on the top layer of filter gravel, eventually resulting in the breaking-through of the filter. An idea of the volume of air so liberated may be obtained from Fig. 2 which shows the surface of a filter being jolted to relieve air-binding. At times a 3-in. wash could be maintained for six minutes before all the air in the underdrain system was displaced sufficiently to allow the wash-water to spill over the gutters.

Use of Cemented Gravel Layer—As soon as it was concluded that the displacement of the top layer of gravel (¾- to ⅜-in. size) was due primarily to air-hammer, efforts were made to remedy this condition by cementing this gravel in a manner similar to what has been done in Toronto and elsewhere. Over the lower layers of gravel in one of the filters there was laid a 3-in. slab consisting of one part of neat cement mixed with nine parts of the top gravel by volume. Due to the exigencies of operation, it was impossible to experiment with more than one filter, and even with this one, a thorough test of the value of cemented gravel could not be carried out. However, sufficient information of an encouraging nature was secured to warrant investigating this matter further with particular reference to the possible use of cemented gravel underdrains in the next group of filters to be constructed by the city. In this connection, the following general conclusions, based on experience already gained through the trial

FIG. 1—PARTLY COMPLETED FILTER UNIT EQUIPPED WITH WOOD-GRATING UNDERDRAINS

of cemented gravel in one filter, will serve as a guide in future design:

(1) The use of cemented gravel is thoroughly practicable from the hydraulic standpoint; i.e., giving the required discharge with reasonable loss of head and even distribution through the slab.

(2) Greater mechanical strength is needed than that afforded by a 3-in. layer of 1:9 cement-gravel mix.

(3) This additional required strength can probably be obtained by increasing the depth of slab to about 8 in. and allowing it to act as a beam, with proper reinforcement with wire mesh near the top face.

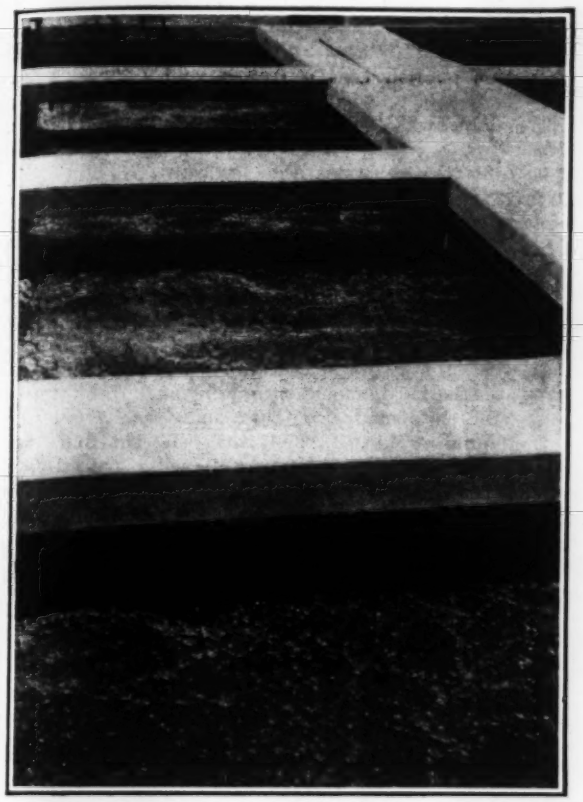


FIG. 2—LIBERATION OF LARGE VOLUME OF AIR DURING JOLTING OF FILTER TO RELIEVE AIR-BINDING

The results of the test showed that the cemented gravel layer as constructed would not be satisfactory because of local defects. In the west half of the filter the water broke through in several places, causing an upheaval of the sand bed. Similarly, a large blow hole developed in the east half, the upward rush of water carrying the sand over the neighboring gutter. Prior to replacing the sand bed, the gravel slab had been back-washed; at that time it was observed that in each half of the filter a longitudinal crack developed, indicating that the cemented gravel was acting as a beam spanning the 12-ft. width of the filter bed, and broke at the points of maximum bending moment and along a plane extending the length of the filter and roughly midway between the side walls of each half-unit.

Reinforcement Necessary—In using cemented gravel, it is evident that a correct balance must be struck between the depth of gravel slab to secure mechanical strength and the resistance offered by that depth, in terms of the water uplift against the slab and tending to float it. This consideration is of more importance in case the cemented gravel is placed in small slabs or blocks which depend for their stability on their weight in water being greater than the upward thrust of the wash-water passing through them. If the slab is cast monolithically, which has an advantage in decreased cost of construction and a disadvantage in increased difficulty of securing a uniform layer, it may be designed to act as a floor slab to take upward thrust, so that the depth and consequent resistance may be made enough to secure the desirable property of offering appreciable friction to the passage of the wash-water. This tends to insure stable hydraulic conditions, mainly by compensating for the slight inequalities in static head underneath the whole system. It has been found that the resistance through the cemented gravel is remarkably small, the 1:9 cement-gravel mix at Sacramento showing only 0.15 ft. for an 18-in. vertical rise of wash-water per minute and 0.5 ft. for a 48-in. rate. It is considered that these losses are too small and are open to the same objection that the use of the wood-grating underdrains entails.

It is believed that the development of a cemented-gravel layer for use in conjunction with false-bottom underdrains should prove of great value in offsetting the disadvantages these underdrains have under certain conditions where a displacement of the top layer of gravel in the filter bed takes place. If the functioning of the wood-grating filter bottom can be assisted by a cemented-gravel slab, its cheapness of installation as compared with perforated-pipe underdrains will become of more importance than it is now. However, it still remains to be proved whether even this combination can excel the perforated-pipe underdrains for dependability under all operating conditions in respect to the production and maintenance of a uniform back-wash throughout the filter bed.

Somewhat approximate measurements of the loss of head that may be expected through a wood-grating underdrain system like the Sacramento design have been made and are given below.

LOSS OF HEAD WITH WOOD-GRATING UNDERDRAIN SYSTEM

Rate of Wash		Loss of Head
Vertical Rise Inches per Minute	Cubic Feet per Square Foot per Minute	Feet of Water
3	0.25	2.53
6	0.50	2.65
9	0.75	2.75
12	1.00	2.82
15	1.25	2.89
18	1.50	2.96
21	1.75	3.03
24	2.00	3.10

The loss of head refers to the static water head in the distribution channel required to produce the given discharge through the slat bottom, a 13-in. bed of graded gravel, and 34 in. of clean sand of 0.42-mm. effective size.

Designers will recognize the fact that, in comparison with the head requirements of the perforated-pipe underdrains, the slat bottom offers an advantage in lower frictional losses, particularly beyond the 12-in. rate of wash. Yet, as already explained, this advantage is of doubtful value in view of the delicate hydraulic equilibrium associated with these low resistances.

Rheims Plans Canal Port Works

Paris Correspondence

The municipal council of Reims, France, has decided to proceed immediately with a project for the construction of a new port on the Aisne and Marne Canal. The city bought the ground involved early in 1914. The general plan calls for an expenditure of 2,400,000 francs, of which the national government is to take half of the charge. A credit of half a million francs has already been passed with the stipulation that 300,000 francs of this amount will be devoted to excavation work to give unemployed labor something to do.

Dam Floods Danville Water-Works Requiring Replacement

Rearrangement of Works by Putting Filters in City of Danville, Ky., at End of Four-Mile Pipe Line Lengthens Life 20 Years

By Paul Hansen
Of Pearse, Greeley & Hansen, Consulting Engineers, Chicago

CONSTRUCTION of the high rock-fill dam for power development in the Dix River Valley by the Kentucky Hydro-Electric Co. forced an unusual problem on the water department of Danville, Ky. This dam, described in *Engineering News-Record*, April 2, 1925, p. 548, has a total height of 250 ft. and, though 28 miles below Danville, will back up the water to a depth of 50 ft. at the site of the present Danville water-works pumping station and filter plant. During flood stages the depth of water at the existing works may be as much as 70 ft. The Kentucky Hydro-Electric Co. was in consequence under the necessity of providing a new water-works for the city of Danville. This work was done under arrangement with the city whereby the city was permitted to select engineers satisfactory to the hydro-electric company and whereby the cost of the works was to be met by it.

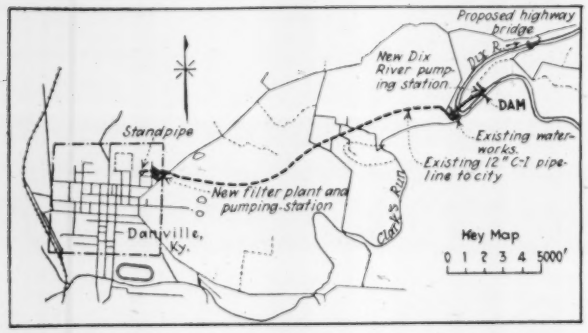


FIG. 1—DANVILLE WATER WORKS REARRANGED

The old water-works plant is located in the valley of the Dix River about four miles in a northeasterly direction from the city (Fig. 1). The water is taken from above a 16-ft. dam, filtered, and then pumped to the city through a 12-in. main about 20,000 ft. long. The difference of elevation between the Dix River and the city is 260 ft. Within the city is a standpipe 16 ft. in diameter and 150 ft. high, having a total capacity of 225,000 gal. and an effective capacity within the upper hundred feet of 150,000 gallons.

The population of Danville is about 5,500 and growth is slow. The average water consumption is a little under 1 m.g.d., about half of this being used by the Southern Ry. shops.

On account of heavy friction losses from Dix River to the city, it is often difficult to deliver water in sufficient quantities. The maximum rate at which the existing steam pumps can operate is 1.5 m.g. daily. At times the rate of demand exceeds this, principally on account of heavy draft by the Southern Ry. shops. In view of the fact that the new plant is to be electrically operated it was feasible to place a raw-water pumping station at Dix River and build a filter plant and filtered-water service pumps on the edge of the city. By placing adequate storage at the city plant it becomes possible to pump at a uniform rate through the pipe line from the river during any 24-hr. period, or perhaps even longer, thereby greatly increasing the effective capacity of the pipe line with a given friction loss. The permissible friction loss is also increased by reducing the static head by about the height of the standpipe. In fact it is estimated on the basis of the present population growth that the effective life of the pipe line has been increased not less than 20 years. As a replacement of this pipe line would cost approximately $120,000 this simple modification of the plant arrangement represented a material economy. There is a further practical advantage in having the main works in the city inasmuch as experience has shown that it is hard to keep laborers contented four miles from the city.

Pumping Station at River—The pumping station at Dix River had to be designed to operate with a water level in the river varying as much as 70 ft. To accomplish this result a tall pump shaft of reinforced concrete was built in the river valley just below the existing water-works dam and adjoining an almost precipitous cliff. Surmounting this shaft is a pumping station building (Fig. 2). Within this shaft are two 5-stage deep-well electric-driven impeller pumps, suspended from steel beams in the superstructure. All bolts and connecting pins are of monel metal. An overhead traveling crane is provided. It is thus a relatively simple matter to raise and disassemble the pumps for repair and inspection. To insure favorable operation of the pumps, extra heavy shafts were used and the pumps and pump casings are supported by thrust bearings of extra large size. These precautions will keep the impellers in adjustment and avoid vibration.

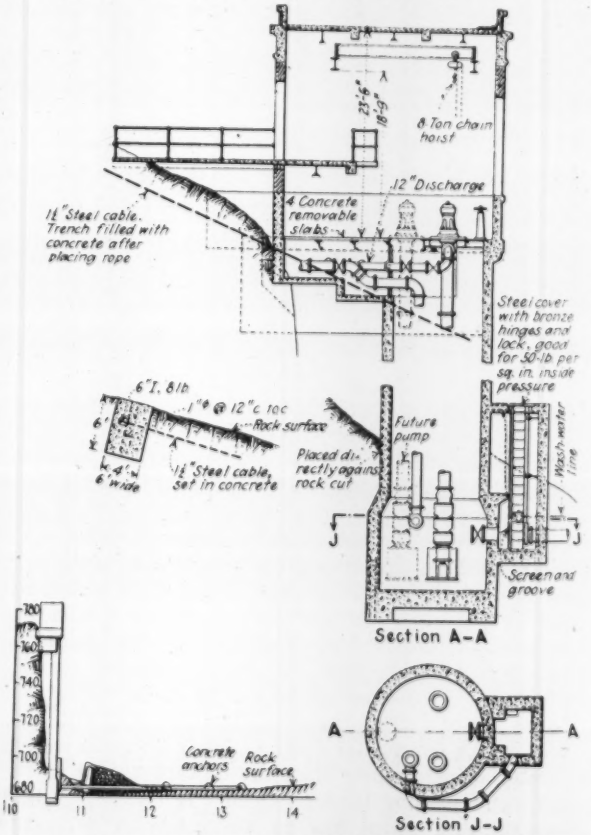

8 Ton chain hoist
12" Discharge
4 Concrete removable slabs
1¼" Steel cable. Trench filled with concrete after placing rope
Steel cover with bronze hinges and lock, good for 50-lb. per sq. in. inside pressure
6" I. Blb
1" ø @ 12" c. to c
Rock surface
Future pump
Placed directly against rock cut
1¼" Steel cable, set in concrete
Wash water line
Screen and groove
Section A-A
Concrete anchors
Rock surface
Section J-J

FIG. 2—RIVER PUMPING STATION TO CARE FOR 70-FT. VARIATION IN WATER LEVEL

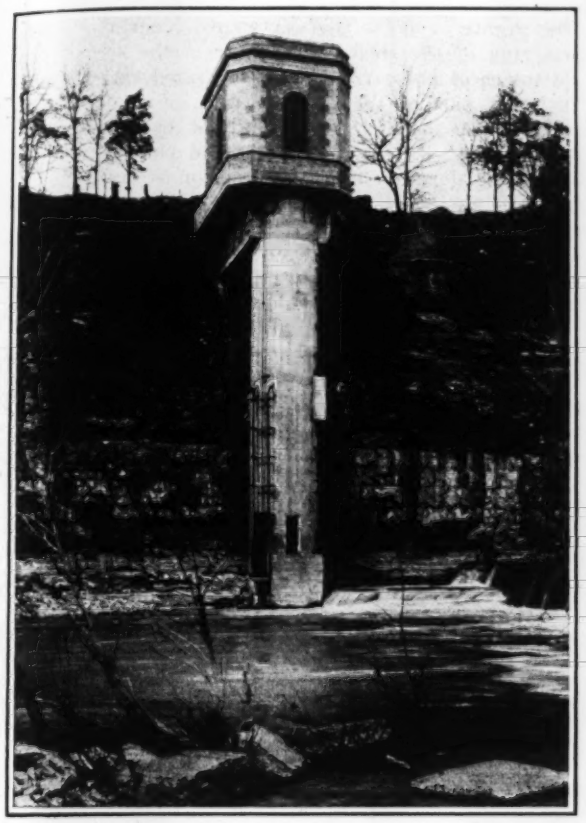


FIG. 3—PUMPING STATION AND SHAFT, DANVILLE, KY. Intake suction pipe passes through dam at right. Two gates on shaft to take water at higher elevations when stream is flooded.

Each pump has a nominal capacity of 1.5 m.g.d. against a head of 346 ft., which comprises 260 ft. of static head and 86 ft. of friction head. The combined efficiency of the pumps and motors is approximately 66 per cent. Operating together, the pumps can deliver about 2.25 m.g.d. against a total head comprising the same static head as above and a friction head of 183 ft. There is room in the shaft for a third pump should it ever be desired, though at the present time this space is occupied by an iron stairway which gives convenient access to the shaft. This pumping station is controlled in its operation from the main station in the city.

Pumping Station and Filtration Plant in City—At the city station are a mechanical filter plant with a nominal capacity of 1.5 m.g.d., a 0.5-m.g. clear-water storage reservoir and high-service pumping station.

The filter plant proper comprises the following elements: (1) Chemical feed devices consisting of wooden storage tanks and the usual chemical feed boxes. (2) A mixing chamber with a retention period of about 15 minutes. (3) Two coagulating basins with a combined nominal retention period of 4 hr., so arranged that they can be operated independently in parallel or in series, with or without the mixing chamber. The retention period of the coagulating basin is made rather liberal because with floods in Crab Orchard Creek, a tributary of Dix River, the water does not coagulate and settle readily. (4) Three rapid filter units of the usual type, each with a nominal daily capacity of 500,000 gallons.

Special features of the filter plant are an unusually roomy and light pipe gallery and a large, light and roomy filter operating room. The superstructure covers the filters, mixing chamber and the ends of the sedimentation basins. The clear-water reservoir is made quite large so that it may tide over any interruption of pumping at Dix River that may result from breakdowns at the pumping station or on the transmission lines. Because of the fact that power will come into the city from three different directions, it is believed that 8-hr. storage on the basis of the nominal capacity of the filter plant should be sufficient. Moreover, in a small city of this character it is feasible to check promptly water consumption by signal or otherwise. If the Southern Ry. shops are stopped from using water the consumption rate would be cut in half.

The pumping equipment includes a centrifugal wash-water pump operating under low head and capable of creating a rate of wash in the filters amounting to 24 in. vertical rise per minute, and three centrifugal service pumps with capacities of 0.75, 1 and 1.5 m.g.d., respectively. The largest pump, which will generally serve as a fire reserve, may be driven either by an electric motor or a gasoline engine.

An effort has been made to secure a good appearance of all buildings without extravagance. Because of the conspicuous location of the plant near the city, some attention has been given to parking and landscaping. A landscaping plan will be carried out during the coming summer.

The new works were designed and built under the supervision of Pearse, Greeley & Hansen, engineers, Chicago. The resident engineer was George B. Prindle. A. J. Authenreith and G. W. Hamilton represented the Kentucky Hydro-Electric Co., as engineers. Henry E. Woolfolk, superintendent of water-works, and Anton Rehm, chief engineer of water-works, represented the city. The contractors for construction work, including buildings were Cope & Fisher of Decatur, Ill. The contractor for erection of pumping machinery, piping and filter equipment was the Roberts Filter Manufacturing Co. of Darby, Pennsylvania.

Developed and Potential Water Power

The developed water power of the world in 1920 was about 23,000,000 hp., according to an estimate made by the U. S. Geological Survey in 1921 and, according to the same source, at the end of 1923 the developed power was about 29,000,000 hp., or an increase of 25 per cent in about three years. The increase was about 1,500,000 hp. in North America, 3,400,000 in Europe, and 1,000,000 hp. in Asia. The installed capacity for the United States at the end of 1923 is given as 10,000,000 hp. and the potential power as 35,000,000, but the Geological Survey states that with complete development the installed capacity will be about 70,000,000 hp. or more, so that only about 14 per cent of the total resources of this country has yet been developed. The estimated waterpower resources of the world are given in the accompanying table.

Continent	Horsepower Developed	Horsepower Potential
North America	13,700,000	66,000,000
South America	675,000	54,000,000
Europe	12,300,000	57,000,000
Asia	2,000,000	69,000,000
Africa	14,000	190,000,000
Oceanica	220,000	17,000,000
Approximate total	29,000,000	453,000,000

Oil Tank Fails After Sudden Drop in Temperature

Two Tanks Destroyed in Fire Apparently Caused by Rupture of One Tank—Sudden Cold Snap May Be Responsible

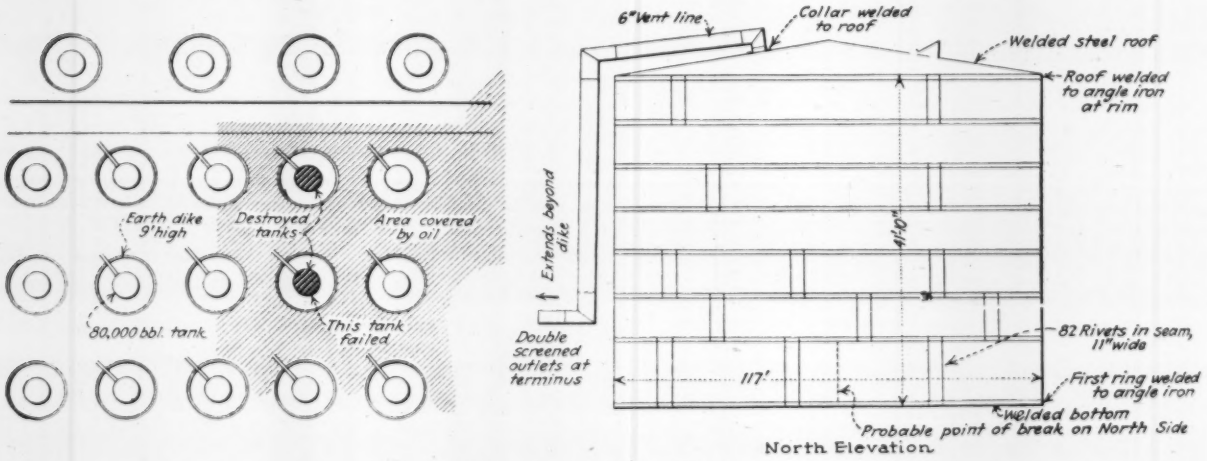
A FIRE destroyed two oil tanks of the Marland Refining Co. at Ponca City, Okla., on Dec. 19, apparently originating through the ignition of escaping oil after the rupture of one tank. The cause of the rupture has not yet been determined. Unusual temperature conditions prevailed just before the break, and these may have something to do with the accident.

A long period of mild weather had preceded. A day before the accident the temperature dropped from about 60 deg. F., and on the morning of Dec. 19 it was 4 below zero. About 6 a.m., Dec. 19, one or two light muffled sounds were heard and it was at once seen that there was a large fire among the group of tanks. This, it turned out, was due to the rupture of one tank (the lower of the two shaded tanks in the sketch plan herewith). So far as any direct testimony is available, the fire, the small explosion and the rupture were simultaneous, and it cannot be determined which came first. All plant employees on the fire list were at once called. The outrush of oil was so great, especially to the northward of the tank, that the earth dike around the tank was overtopped by the flow, as were also the dikes of some of the adjacent tanks. The flooded area is indicated in the plan. All tanks were filled with high gravity crude oil, except the one directly east of the ruptured tank, which was only about one-sixth full (containing at the time a depth of 7 ft. 4 in., or about 14,000 bbl. out of the total capacity of 80,000 bbl.). This tank was destroyed during the fire, the entire upper portion and roof being warped and crumpled to the inside, leaving only two or three rings standing. The sag of the shell toward the south, apparently, tore the first ring free of the welded base angle connection along the north side of the periphery.

After the fire, the condition of the tank in which the trouble originated was as follows: Roof, shell and bottom were entirely separate. The bottom was disturbed very slightly, and the roof lay almost covering it. The first ring of the shell was torn from the second ring a distance of about 180 ft. and separated entirely from the other part of the shell, as well as from the curb angle of the base, to which it had been electrically welded. The sheets from the second ring to the roof were torn along an irregular line, offset by distances as much as the length of two or three sheets (each sheet about 18 ft. long). The shell was pushed back, to the south, to the earth dike surrounding the tank. The roof showed no large fissure that would indicate any explosion.

Dimensions of Tank—According to V. T. Moon, chief engineer of the company, the tank was 117 ft. in diameter by 41 ft. 10 in. high. It had been filled about a month before. At the time of the accident no oil was being pumped into or out of the tank.

The bottom was made of ¼-in. rectangular plates and ⅜-in. sketch plates, electrically welded on the upper side, and bordered by an angle ring welded to the bottom and riveted to lower ring of shell. The shell was riveted. It consisted of seven rings, respectively ⅝ in., 11/32 in., ½ in., 7/16 in., ⅜ in., 5/16 in. and ¼ in. thick. It was edged with a 3x3x⅜-in. angle at the top. The vertical joints of the two lower rings were butt joints, the others lap joints. The first ring had ⅞-in. rivets about 2¾ in. on centers, the others ¾- and ⅞-in. rivets, spaced 2½ in. and 2 in. respectively. The actual joint efficiency may have ranged from 65 to 85 per cent.



LOCATION PLAN AND SKETCH ELEVATION, PONCA CITY TANK

The roof was made of 7/16-in. plate on structural steel framing, and had about 2 ft. rise from eaves to peak.

The main break in the lower ring of the shell, which is believed to be the starting point of the rupture, was a clean break, practically square to the length of the plating, located about 6 ft. from a vertical joint, and at or near a joint in the curb angle.

According to a report on the accident by H. W. Henry, of the Oklahoma Inspection Bureau, to appear in the National Fire Protection Association *Quarterly* for April, the best information is that there was no lightning or similar atmospheric disturbance on the day of the accident, that there was no loud report indicating any considerable explosion, and that the local people

consider that no defective welding or insufficient or improper riveting was involved.

A view of the accident held by some of the oil company people is that the accident resulted from a break in the lower shell ring, possibly due directly to the sharp drop in temperature causing contraction of the shell while the oil in the interior and the plating of the bottom were still at a temperature not much below 60 deg.; and that the outrush of oil through the break or the tearing of the metal created a spark which set fire to the oil vapor.

Sacramento Filter Plant Report Advises Extensive Repairs

Settlement and Cracking Attributed by Structural Engineer to Faulty Original Design—Eight New Filters Advised

IMMEDIATE repairs and reconstruction of the Sacramento filter plant to cost $100,000 are recommended in the report of H. D. Dewell, consulting engineer, San Francisco, made to the Sacramento City Council on April 2. Dewell also recommends that construction be started at once on a bank of eight new filters to cost about $330,000. These new units are to replace old ones the cost of repair of which would be excessive, and at the same time to provide needed additional capacity.

As reported in *Engineering News-Record*, Sept. 4, 1924, p. 375, attention was called to deficiencies in the filter plant by the failure, on June 24, 1924, of the concrete wall between the grit basin and sedimentation basin 3. This break was made the subject of a report to the city authorities by Charles Gilman Hyde and George J. Calder, chief consulting engineer and resident engineer, respectively, on Sacramento's water filtration project. The Hyde-Calder report stated that an examination of the original plans and subsequent tracings showed that although the wall was properly designed to take unbalanced load from either direction, an error was made by the tracer who copied the original plans in the process of making up contract drawings. For one side of the wall he showed only 25 per cent of the amount of steel called for on the original drawing.

This simple explanation apparently was not concluded to be sufficient by Mr. Dewell, who was retained by the city some months ago to make an analysis of the causes of structural failures and settlements in the plant and to recommend needed repairs. His report states: "The filtration plant is far from satisfactory from a structural standpoint." All structures, with the exception of the intake pier, the bridge abutment and the central portion of the pumping station, have settled since they were completed. Just how much settlement is uncertain on account of faulty records; the maximum in structures on piles may be as much as six inches and in those on spread footings possibly as much as one foot.

Some of the damage from this settlement is listed as follows: (1) Both banks of filters have cracked away from the main building and are out of level. (2) Certain walls of the pumping station are cracked. (3) Walls of the areaway of the coagulant building have settled and are out of line. (4) The walls of the sedimentation basins are cracked and cracks occur also in the roof over the sedimentation basins and in the floors of the grit basins. (5) The central conduits in the filters are cracked. (6) There is some evidence for the belief that the 36-in. bypass along the west wall of the sedimentation basins has cracked.

The report places blame for this settlement squarely upon those who made the structural design, stating that there were improper assumptions, a failure to give proper consideration to ground conditions and faulty design of beams and walls. Dewell's report states: "With the uncertainties which exist as to the ability of the structure to withstand further possible settlement and the deficiencies in design, the writer cannot guarantee its future stability or take any responsibility for its future behavior."

The report further states, however, "Outside the actual failures including cracking and settlement the plant appears to be functioning satisfactorily after approximately a year's service. If no further settlement occurs it is extremely probable that with the repairs recommended the plant will give satisfactory service for many years to come."

Recommendations for repair include a temporary pumping plant during the reconstruction to bypass the water from the head house to the pumping station through a 60-in. corrugated steel pipe to be laid for this purpose. They also advise that the 36-in. bypass of the sedimentation basins be paralleled by a similar line and that the bypass gate structure at the northwest corner of the grit basin be raised.

Practical difficulties in renewing the foundations under certain parts of the filter beds where settlement is serious would make the repair cost practically equal to the original cost of these units, hence the recommendation for a new bank of filters which would replace these and at the same time provide needed increases in capacity. The $100,000 recommended for expenditure on repairs is about 4 per cent of the initial cost of the work.

Simultaneously with the submission of the Dewell report the Sacramento city manager announced that the repairs, to cost $100,000, will be started at once, but that construction of additional filters, which would require a bond issue, will not be considered for some time at least.

Industrial Simplification in Sweden

Simplification of practice is progressing well in Sweden, according to a note in a recent bulletin to sustaining members from the American Engineering Standards Committee. The Swedish Committee on Industrial Standardization has adopted 71 mechanical standards. The number of railroad coach screws has been reduced from 200 to 19. Army lamps have been reduced from 200 to about 75 types, resulting in an annual economy of some $2,400 for the army. Standardization of pipe and fittings is now under study. The committee has asked a government credit of $19,000 for the coming year's operations. Standards for tolerances of cylindrical parts have been drafted, and a draft standard for rivets with countersunk flat and spherical heads has been issued. These heads have countersunk angles of 70 deg. for diameters from 6 to 13 mm., and 60 deg. for diameters of 13 to 38 mm.

Minneapolis Building 210-Ton Garbage Incinerator Plant

By J. A. Jensen
Engineer, Water-Works, Minneapolis, Minn.

THE CITY of Minneapolis has recently let a contract for a garbage incinerator with a rated capacity of 210 tons per 24 hours. The plant will consist of three 75-ton units of a modified brick type. There will be employed cast-iron tuyere plates instead of the usual grates. The furnace section of each unit will have three tuyere-plate fireboxes separated by two tilting drying grates. Forced draft is used and the air is partially heated in ducts passing through the combustion chambers and also by contact with the grate and tuyere plates before entering the fire. This will keep the plates at temperatures designed to prevent their injury by the fire.

The fireboxes are 5½ ft. deep, which renders stoking easy. The drying grates are made to tilt to the right or left to deposit the drying garbage in any firebox desired. The gases are passed through a combustion chamber at the rear by means of two openings in the rear wall. In the flue a part of the heat can be by-passed through a heating boiler.

Clinkers, ashes and soot are removable by means of tunnels below the operating floor. The combustion chambers have bottom gates for the purpose. The ashes are delivered to a skip hoist which deposits them in a 15-cu.yd. hopper.

The fan suction is taken from the clinker pits through a dust chamber for sedimentation, from hoods over the furnace doors and through funnels from the charging floors. By this means foul air or smoke will be passed through the fire.

The garbage will be handled by overhead cranes and discharged into hoppers with controlled gates, one tank to each charge of 4 cu.yd. The gates permit the garbage to descend through a pocket against a second gravity door above and back of the fire. These two sets of doors form an air lock, so to speak, between the furnace and the charging floor. The garbage is hauled in removable steel tanks which may either be stored on the charging floor for night burning or be dumped into the fire. A 175-ft. radial brick chimney will carry the gases well into the atmosphere.

The garbage to be burned is delivered in the wrapped form, which is a method popular with the housewife in this climate. By this treatment it is drained of water at the kitchen sink, wrapped in paper and placed in a 20-gal. can at the alley. In this condition it does not freeze fast to the sides of the can in winter, nor stick to the can or foul it in summer, thereby eliminating odor and flies which is very desirable, and fulfills the first requirement of sanitation. The garbage is of a quality between free garbage and the usual mixed refuse and garbage of most eastern cities.

No attempt is made to utilize waste heat, except to apply it to the process involved. Drying and incineration, by employing as much retained heat as possible, will be the principle involved. The analysis of the garbage indicates that not more than 50 lb. of coal should be necessary per ton of garbage in this furnace. In the present plant the average coal consumption per ton in 1923 was 100 lb. and in 1924 it was 71 lb. The reduction was due largely to the use of a locally designed brick furnace serving a vertical steam boiler.

In the incineration of garbage the combustible present must produce sufficient heat units for the elimination of moisture. If there is a deficiency of combustible, coal or other fuel must be supplied to produce a proper heat balance. Where an attempt is made to utilize "waste heat" it results in robbing the incinerator furnace of its heat and interfering with combustion due to lowered temperatures. It becomes necessary to add coal to "make up" and properly destroy the garbage. It appears that if heat is to be used for power it is preferable to utilize it directly in properly designed boilers than to saddle this duty upon a garbage incinerator and thereby disturb its proper functions.

For these reasons this plant was adopted to reduce garbage incineration to its simplest terms, and permit the destruction by proper utilization of its own heat as far as it is possible to do so, and add fuel only when it is necessary to restore a proper heat balance.

The new plant is three miles closer to the center of the city than the old one which will result in a considerable saving in hauling costs. An effort is being made to enjoin the city from constructing the plant at this location and a hearing has been ordered.

The contract was awarded to the Goder Incinerator Co., of Chicago, for $204,100, which includes the incinerators, building, chimney and all necessary equipment needed for operation. The contract guarantees that complete and satisfactory incineration will be accomplished with 1¼ man-hours per ton or seven men per shift not including supervision. On an August analysis of wet garbage as a basis it is guaranteed that not more than 75 lb. of extra fuel will be required per ton of garbage. Two other bids were received for this plant, the amounts being $352,612 and $352,400 respectively.

The Goder Incinerator Co. has built an 80-ton plant at St. Louis, Mo.; a 50-ton plant at Joliet, Ill., and a 40-ton plant at Whiting, Ind., besides plants at Army and Navy Stations in the United States and Canada. The company also has numerous industrial incinerators in hotels and apartments, and has done considerable work in waste heat boiler work. The experience of the company in garbage and refuse disposal is based to a large extent on German practice.

It is hoped that the new plant at Minneapolis will be ready for preliminary testing by the middle of August.

Instruments for Airplane Mapping

Two new instruments, a magnifying stereoscope and a camera lucida, have been designed and built by the Bureau of Standards, Department of Commerce, as aids in map making by means of airplane photography. The stereoscope, built for the Coast and Geodetic Survey, is to be used in picking out triangulation stations when airplane photographs are used to supply details for a map based primarily on a ground survey. Such stations are generally flagstaffs, church steeples, and other high objects. The stereoscope makes high objects stand up in a conspicuous manner. The camera lucida is used for transferring points to the map in cases where a line map is to be made and not a photograph. It is especially designed to correct for the variations in scale and for the distortion due to roll and pitch of the plane which are unavoidable in airplane photography. The photograph, horizontalized and brought to the proper scale, is projected upon the map and the desired points and lines are traced in with a pencil.

Plugging a High Pressure Tunnel, Buffalo Filter Plant

Water Bearing Shaft to Tunnel Under 66-ft. Head —Balancing Pressures Difficult—Third Trial Method Successful

By C. S. Rindsfoos
Secretary-Treasurer, Jarrett-Chambers Co., Inc., New York City

The construction of the Buffalo filter plant, described in "Engineering News-Record" Feb. 19 and 26, pp. 322 and 358, involved some troublesome underground construction to deliver the filtered water into the old raw-water distribution system. The largest of these operations was to plug the old Massachusetts Ave. tunnel 80 ft. below ground and 66 ft. below lake level, as indicated on Fig. 1, and sink a new shaft (Shaft 4) to connect the high-level filtered water conduit from the pump well with the low-level Massachusetts Ave. tunnel. This operation is described in the following article. —Editor.

PNEUMATIC shaft sinking and difficult divers' work in a water-filled tunnel 80 ft. below ground were the essential operations in connecting the new Buffalo filter plant, through the old tunnel, to the city distribution system. The structures built are shown by Fig. 2, which also indicates the general method of construction.

Shaft Sinking—A hole was first excavated, by a half-yard orangepeel bucket, to a depth of 14 ft., or to a point just above water level. The ground consisted of an ash and clay fill and was allowed to take a natural slope leaving a space some 18 ft. in diameter at the pit bottom. This afforded room to set the cutting edge and forms for the circular concrete caisson. Then 3-in. planks were laid on the bottom of the open cut and on these the cutting edge was assembled. The concrete caisson was then molded with removable wooden forms, to a height of 24 ft. The plank and forms were then removed and the caisson was sunk by open dredging, 8 ft. to El. 566. The caisson was then built up to about its final required height and again ditched to rock at El. 554. No attempt was made to pump or exclude the water during this period.

After reaching rock it was found impracticable to unwater the shaft sufficiently to drill and blast, as water came through seams in the rock in considerable volume. A timber deck, for which slots had been left in the caisson walls, was then placed, an air lock installed and air pressure applied. The space between the cutting edge and the rock was then packed with clay in bags and the bottom dried, after which the clay was replaced, bit by bit, with concrete, to effect a permanent joint between the caisson and the rock.

Rock excavation began 12 ft. in diameter to allow for a concrete lining 1 ft. thick. The rock is a flinty limestone, dulling steels quickly and requiring more than the average amount of dynamite to break it, but when blasted it breaks very fine. Moreover, the rock is very seamy and, after the first 3½-ft. cut had been made, a 2½-in. seam was uncovered which made it exceedingly difficult to hold the air pressure. Constant "mudding up" with clay and cement mortar was necessary so that, after this cut had been cleared, the first section of the lining was put in to make the shaft tight down to this point. Excavation proceeded for another 3½ ft., when another and similar water-bearing seam was encountered. This was grouted and this so effectually stopped the water that the air pressure was removed and drilling and blasting were resumed "in the open." The blasting, however, soon opened up the seam

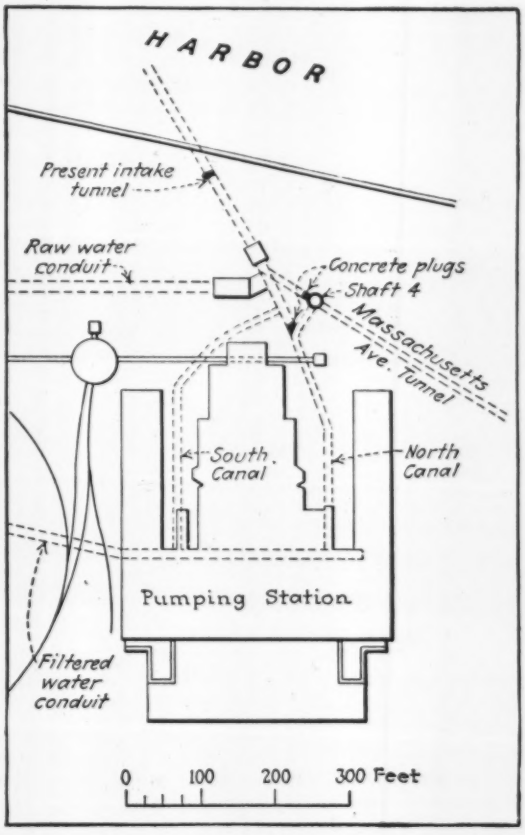


FIG. 1—LOCATION PLAN OF SHAFT AND TUNNEL

to such an extent that it was found advisable to cement it and re-apply the air pressure.

At El. 542 the rock appeared harder and less seamy, so a second ring of shaft lining was put in place, to secure the work above, and the air pressure was again removed. Work in the open now continued for some 10 ft. when a third seam was struck through which the water came in volume and under a head that caused it to spurt up 8 ft. Grouting of this seam was unsuccessful, and pneumatic work was resumed, the seam plugged with mortar and another section of concrete shaft lining placed, thus securing the work down to El. 530.

Rock excavation was now continued as before, under air, to El. 522, at which point test holes were drilled and the concrete arch of the Massachusetts Ave. tunnel was located.

It should be observed that the exact location of this old tunnel, into which the shaft was being sunk, was not accurately known either as to depth or position in plan. The water in this old tunnel was under a head of 66 ft. and hence a pressure of about 30 lb. was anticipated. The pressure we were using in the shaft was at times much less than theoretical except when a bad seam was met. Therefore, to break into the old

tunnel unexpectedly might have caused the shaft to fill almost instantaneously and trap the workmen. For this reason as the work approached the old tunnel it was prosecuted with great caution and the test borings referred to above were made.

Having located the tunnel, the arch was broken through, an air pressure of 26 lb. sufficient to hold the water at 6 in. over the roof being maintained meanwhile. The air pressure and lock were next removed, the shaft allowed to fill with water, and such material as had fallen into the tunnel was taken out by clamshell.

Plugging Old Tunnel—The next step was to build two bulkheads, one of permanent character to exclude the raw water from the intake side of the Massachusetts Ave. tunnel, marked *A* on Fig. 2, and a temporary one, marked *B* on the opposite side of the shaft, the two making a cofferdam in which to make the permanent connection between shaft and tunnel.

Divers, working two men at a time in two-hour shifts, built the bulkheads, a gate on the intake side being first closed as otherwise they would have been swept along with the current. Air was furnished direct from the motor-driven air compressor located above ground. The divers regulated the air pressure themselves by a needle valve on the hose within reach of the right hand. The helpers above also had a valve and gage on the line on which they maintained 40-lb. pressure, which was reduced by the diver to about 32 lb.

The concrete bag bulkhead *A* was first started, this being on the intake side of the tunnel. Bags were filled and thrown down the shaft during the half hour between shifts. One diver placed the bags which the other passed to him. When the bulkhead had been built to within 1 ft. of the roof, a strong flow of water, due probably to inability completely to close the intake gate above referred to, prevented closing the opening and work was temporarily stopped while the sand-bag bulkhead *B* was begun on the opposite side of the shaft. The current which prevented making a closure of the one bulkhead was of some assistance in placing the bags in the other. The sandbag bulkhead was carried to the tunnel arch or roof, the final space next to the arch being packed with small bags of clay and oakum.

Work was then resumed on the concrete-bag bulkhead but without success, due to the flow of water and, as it appeared that this might go on indefinitely, the divers were withdrawn and the air lock replaced. The water was blown down to the tunnel arch, a timber working-raft constructed, and the plugging of the concrete-bag bulkhead again attempted. This also proving unsuccessful, the entire space between the two bulkheads was filled with sand and gravel (concrete aggregate) as high as the tunnel arch and the sand-hogs began working back through this sand and gravel to the bulkheads, mudding-up as they went.

This method was successful and the top of the concrete-bag bulkhead was packed tight against the roof. As the sand and gravel which had been dumped between the bulkheads were removed, the face of each bulkhead was covered with 3x12-in. breast-boards, working from the top toward the bottom. The face of the sand-bag bulkhead *B* behind the breast-boards was packed with clay, and a space 1 ft. thick between the concrete-bag bulkhead *A* and its breast-boards was packed with concrete. The breast-boards were held by vertical timbers which in turn were secured by dowels set in the side walls and floor. In addition to the dowels, one

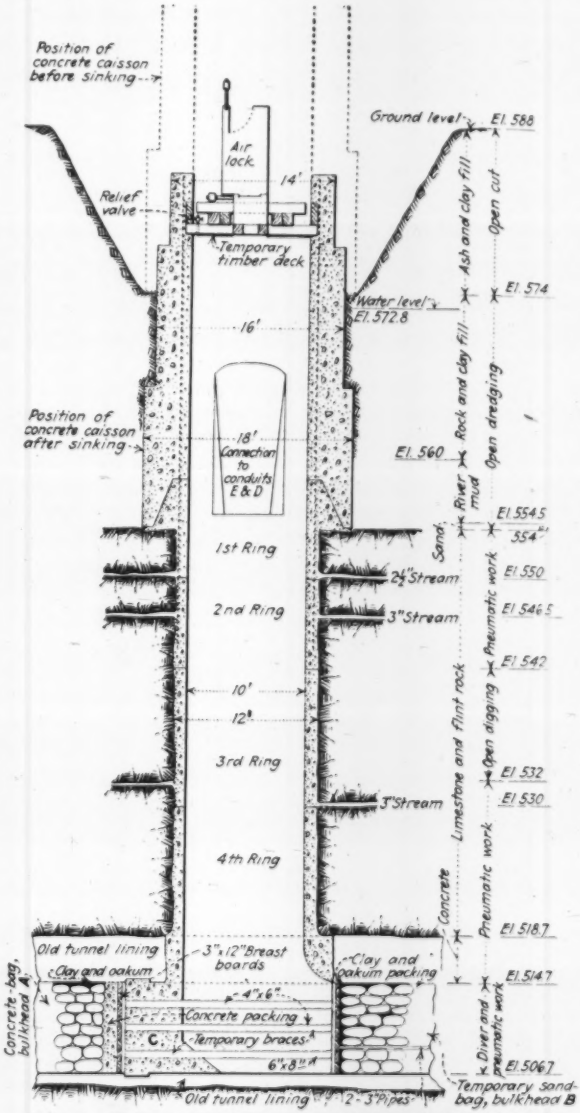


FIG. 2—SECTION OF SHAFT SHOWING SINKING AND PLUGGING OPERATION

line of horizontal timber braces on the center line helped hold this timber facing as shown in Fig. 2.

The installation of this timber work and the breasting down was extremely ticklish. Work could be done on only one bulkhead at a time, since by reason of a 4-ft. difference in head on the two ends of the Massachusetts Ave. tunnel, one side would dry up sooner than the other, and hence the breasting of one side had to be carried about 2 ft. ahead of the other.

It should also be remembered that this shaft and caisson, unlike those usually employed in city and bridge work, was a closed vessel. Air could not be pumped into it regardless. The 3-in. pipes put in one bulkhead were for the purpose of acting as relief or safety valves and likewise an automatic relief valve, set at 30 lb., was mounted on the deck above. The object of these measures was to avoid a catastrophe should the gage tender fail in his duty for any cause, in which case, without such a device, the box might be subjected to too high a pressure. Likewise the supply line was carried

to a point near the bottom for purposes of ventilation. Of course in the early stages of the building of the bulkheads, when they were leaky, these precautions were unnecessary but the tighter the bulkheads became the more sensitive became the balance between air and water pressures on the two sides of either bulkhead and the more necessity was there for extreme caution.

After the bulkheads were finally completed, the permanent concrete plug *C* and the balance of the shaft lining were put in place. The forms and timber braces were removed and, since the sand-bag bulkhead then began to leak there was a consequent loss of air pressure, and finally the face of this bulkhead fell down, and water came in as high as the roof of the tunnel in a few seconds. This, of course, had been anticipated and the men had been withdrawn. The air pressure was finally taken off entirely and the shaft allowed to fill.

The sand bags were then speedily removed by a clamshell bucket, divers working meanwhile throwing the bags within reach below. The opening in the side of the shaft was then cut through from conduit *E* at the upper level, and the connection was complete.

George C. Andrews, engineer, and C. D. Parsons, associate engineer of the Filtration Division, had charge of this work for the city, Fuller & McClintock of New York City being the consulting engineers. The caisson was designed and the contract executed by Jarrett-Chambers Co., Inc., New York City, W. E. Bush having charge in the field.

Rib-Arch Concrete Highway Bridge Over Rock River, Ill.

Twelve Open-Spandrel Arches—Repair of Cracked Rib—Unfinished Spans on Falsework in Winter—Brick Parapets

By Walter S. Todd
Resident Engineer for Whiteside County, Sterling, Ill.

A TWELVE-SPAN reinforced-concrete arch highway bridge over Rock River, which was opened to traffic Dec. 5, 1924, and connects the cities of Sterling and Rock Falls, Ill., presents some points of design and construction which are worthy of note: (1) The simplicity of design and similarity of construction of the

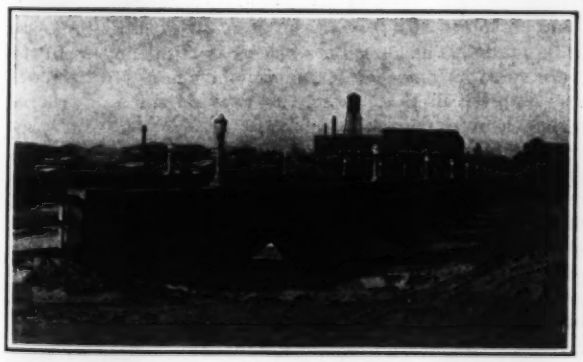


FIG. 1—CONCRETE ARCH BRIDGE AT STERLING, ILL.

various units in the structure, (2) the conditions to be met at the north or Sterling end of the bridge due to the proximity of the tracks of the Chicago & Northwestern Ry., (3) the method of supporting the arch ribs during the winter season to minimize the amount of falsework in the stream, and (4) the settlement of falsework under one arch rib during construction.

This bridge consists of twelve double-rib open spandrel arches having a clear span of 80 ft. 6 in. and a rise of 10 ft. 9 in.; the width of piers is 6 ft. at the springing line, making a total distance of 1,032 ft. between abutments. A roadway 28 ft. between curbs and two 7-ft. sidewalks make a total width of 42 ft. between handrails. The sidewalks extend 4 ft. 6 in. beyond the outside faces of the arch ribs and are supported by cantilever beams. Fig. 1 is a view of the completed bridge and Fig. 3 shows the details of the design.

A camber of 18 in. in the length of the bridge is introduced by increasing the height of the spandrel columns which carry the floorbeams. The roadway slab is 9 in. thick with a span of 9 ft. 1 in. between center lines of floorbeams. It is designed as a simple

FIG. 2—FALSEWORK UNDER UNFINISHED BRIDGE IN WINTER
Temporary footbridge supported on arch ribs.

slab, and is made to act as a simple beam by placing construction joints over the centers of the floorbeams. These joints extend from top of slab down to the reinforcing steel, and are filled with bituminous felt. The wearing surface consists of 2 in. of concrete of a slightly richer mix than the remainder of the slab, and was poured monolithically with the lower 7-in. portion.

The conditions at the bridge site were favorable for construction operations and no serious difficulties were encountered. Over the rock bed of the stream is silt up to 3 ft. in depth, but the elevation of the rock varies only slightly, so that the methods of constructing piers and abutments were almost identical in every case. Rock River is fed by numerous lakes in southern Wisconsin which act as reservoirs and cause a very uniform stream flow throughout the year, while about 500 ft. below the bridge site there is a dam which aids in maintaining the water level at a uniform stage. Due to these facts, there was very little delay caused by high water, and the contractor was assured of ample depth of water to care for floating equipment at all times. The usual depth was 7 to 8 ft.

The main line of the Chicago & Northwestern Ry. crosses the street at grade about 260 ft. from the north end of the bridge and in order to provide a suitable grade to a subway it was necessary to lower as much as possible the crown of the roadway on the first span. For this purpose the floor of the bridge was lowered 18¾ in. by the use of a vertical curve extending 62 ft. from the end of the bridge toward the first pier. The amount to which the floor could be lowered was limited to an elevation where the bottoms of the floorbeams coincided with the under sides of the ribs. In

this case, the main reinforcing steel in the floorbeams was placed before the ribs were poured, and the floorbeams were notched into the ribs with a series of steps. Additional short dowel bars were added to strengthen the beams for shear at their junction with the ribs. By thus lowering the floor, a grade of slightly less than 5 per cent was obtained for the approach to the subway.

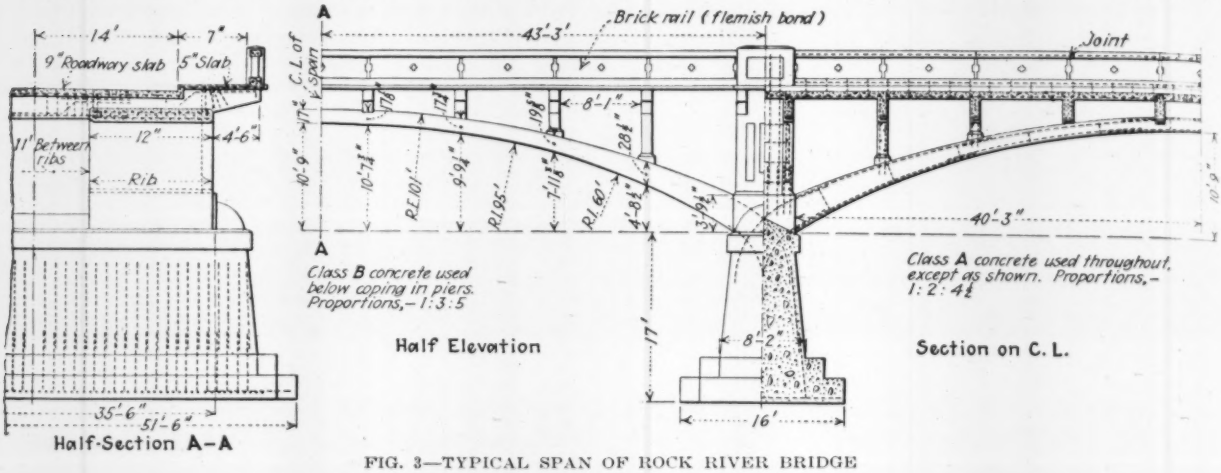


FIG. 3—TYPICAL SPAN OF ROCK RIVER BRIDGE

During the fall of 1923, it became apparent that all of the arch ribs would not be constructed before winter and that the falsework under the ribs of the last two spans poured would have to remain in place in order to minimize the unbalanced arch thrust at the last pier. No abutment piers were provided, and analysis showed that the last pier was unstable with the arch ribs in place. It was necessary to leave a minimum amount of falsework in place, as shown in Fig. 2, to decrease the danger of an ice jam. The upstream side of the falsework bents ended in a V-shaped frame with a steel beam acting as an ice breaker. Fortunately, there were no serious ice jams and when the ice went out the falsework was not disturbed. Fig. 2 shows also the temporary sidewalk which was used to maintain pedestrian traffic during the winter. This was later removed and placed in the stream on wooden bents, beyond the limits of construction activities.

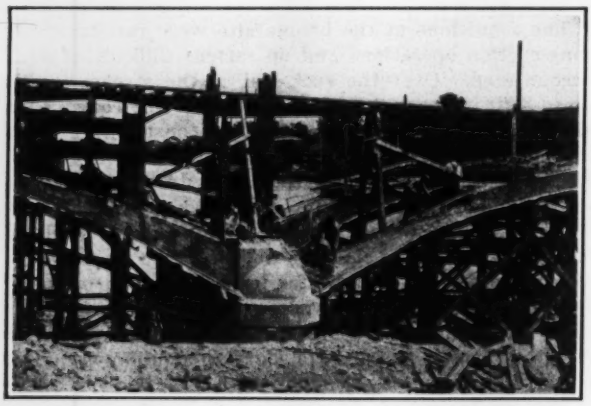


FIG. 4—REPAIRING A CONCRETE ARCH RIB

During the pouring of one of the arch ribs, the piling of one falsework bent settled about 5⅛ in. due to failure to drive one of the piles to refusal. The settlement cracked that portion of concrete in the rib which had obtained its initial set. Due to the settling and cracking of the arch rib, it was thought that the bond between the concrete and reinforcing steel might have been destroyed, and the strength of the concrete was somewhat doubtful. Consequently, it was decided to remove a portion of the rib for a distance extending from the construction joint at the pier to a point about 18 ft. from the face of the pier, as shown in Fig. 4. The concrete was removed by a steam drill and plugs and feathers.

While the work of removal was in progress, levels were taken daily at numerous points on the remainder of the rib to assure that no injurious settlement occurred in that portion of the original pour of concrete which was to remain in place. The falsework was strengthened by additional struts and diagonal braces and a new bent was driven where the former bent had failed. The reinforcing steel originally placed in the rib was cleaned and replaced.

The joint between pier and rib was identical with similar joints at other points in the bridge, but the joint between the original pour and the new portion of the rib was different, since all other ribs were poured continuously. This joint was given careful attention. In removing concrete, the work was done entirely by hand chiseling adjacent to the point where the joint was to be made. The joint was placed at right angles to the main reinforcing steel in the rib, and a horizontal groove was chiseled in the concrete to provide some additional strength at the joint for shear.

This bridge was built at the joint expense of the city of Sterling and Whiteside County. The design was made by the bridge department of the Illinois Division of Highways and is based on a live-load equal to a 24-ton tractor, as required by the state specifications, or a uniform live-load of 125 lb. per sq.ft. on roadway and sidewalk surface. Parapet walls of rough-faced brick, laid in Flemish bond, have copings and bases of concrete 12 in. wide. There are twenty-six boulevard lights of 400 cp., two at each pier and abutment. These lights are on two circuits, so that after a designated hour all but five may be put out. They are mounted on posts of precast reinforced concrete, with the center of the light approximately 10 ft. 3 in. above the roadway.

The contractors were John Moroff & Son, of Kankakee, Ill. The total cost of the bridge was about $178,500.

Testing and Placarding Roadside Waters in Pennsylvania

Less than Half of 841 Supplies Examined Approved by Engineer and Traveling Laboratory Making Tests on Ground

By Earle L. Waterman
Associate Professor of Sanitary Engineering, University of Iowa
and H. P. Drake
Sanitary Engineer, Pennsylvania Department of Health

FOR the purpose of answering the question as to the safety of roadside water the Pennsylvania State Department of Health inaugurated a state-wide survey of the water supplies along the highways of Pennsylvania during the summer of 1924. More than 2,000 miles of main highways were covered by the survey and 1,200 different sources of water supply were inspected by a sanitary engineer. Samples of water from 841 of these sources were examined in a traveling laboratory. As a result of the sanitary survey and laboratory examination, 407 "Safe Drinking Water" signs (Fig. 1) were posted on approved supplies.

The field work was done by a party which consisted of a sanitary engineer, a bacteriologist and an inspector from the Restaurant Hygiene Division. The road equipment (Fig. 2) consisted of a Ford roadster, which was used by the engineer, and a field laboratory. The engineer worked ahead of the laboratory, making a survey of every source of water supply along the highway which might be used. These sources were found at garages, filling stations, tourists' camps, tourists' lodging places, refreshment stands, private homes or simply natural sources of water supply which might or might not be developed for supply purposes. The inspection was made to determine whether the supply was properly located with respect to possible sources of contamination and whether it was properly protected. The facts in regard to each supply were recorded on a

FIG. 1—SAFE DRINKING WATER SIGN

special report blank and an identifying number was assigned. If the source of supply was satisfactory from an environmental and structural standpoint the engineer put up a signal indicating that the laboratory men were to take a sample of the water.

The field laboratory was equipped to make bacterial examinations with the same care that would be exercised in the State Department of Health laboratories. Total counts of bacteria at 37 deg. C., the presence of gas-producing organisms in 1 c.c. and 10 c.c. quantities and the identification of B. Coli were determined. Examination of the samples collected was always started within seven hours after the collection of the sample. For this reason the results obtained were much more reliable than those which might be reported on a sample which had been sent to a central laboratory. High bacterial counts were rare.

The results of the laboratory examination were recorded on the report of the sanitary survey. As samples were taken only from those supplies which were satisfactory from a structural and environmental standpoint, the question of approval of the supply was settled by the results of the bacterial analysis and previous history. The reports were studied by the engineer and the bacteriologist and marked "Placard" if the source of supply was satisfactory from all standpoints.

The reports were then sent to the Bureau of Engineering in Harrisburg where they were reviewed by the Department's sanitary engineer, and instructions for the posting of approval signs sent to the health officers in whose districts the supplies were located. Each approval sign bore the identification number originally assigned by the engineer and a number indicating the year for which the approval was granted. The signs were posted near the source of supply where they could be seen by any one seeking water. In some instances the owner of the supply put up a large sign calling attention to the fact that the water had been approved (Fig. 3).

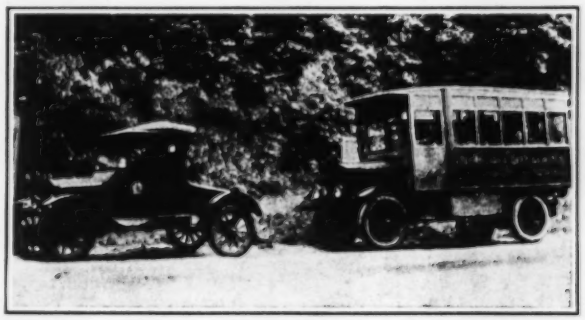


FIG. 2—FIELD EQUIPMENT: ENGINEER'S FORD AND TRAVELING LABORATORY
Engineer cruised ahead and examined supplies from structural and environmental standpoint. Laboratory tested only supplies passed by engineer.

The work done in Pennsylvania covered many different types of country varying from thickly settled agricultural districts to sparsely populated mountainous districts. The itinerary included the Lincoln Highway from Philadelphia through to the Ohio state line; the National Pike, running across the southwestern corner of the state; the William Penn Highway running east and west across the center of the state; the Chicago-Buffalo Road along the shore of Lake Erie in the northeast corner; the Lakes-to-Sea Highway running diagonally across the state from Erie to Philadelphia; the Perry Highway, running north and south in the western part of the state; the Susquehanna Trail running north and south through the center; the Lackawanna Trail, running north and south in the eastern end; and several less well-known connecting highways. These roads traversed all sections of the state and furnished examples of almost every known type of water supply.

The sources of supply found were dug, driven and drilled wells, springs, small streams and cisterns. A detailed study of the final reports on the 841 sources of supply which were examined from an environmental, structural and bacterial standpoint shows that the fol-

lowing actions were taken on these supplies: "Safe Drinking Water" signs posted, 407; approval refused and owners notified, 278; public supplies—not placarded, 55; not permanently safe—not placarded, 90; action pending, 11.

"Safe Drinking Water" signs were posted on those sources of supply which met the requirements of both the sanitary survey and the bacterial examination. Signs were refused and the owners notified that the water should not be used by the public in those instances where the bacterial results indicated some source of underground contamination which did not appear in the sanitary survey. In these cases the bacterial results were very bad. Resampling of the supply with minor improvements was asked for in cases where the sample from the supply gave bacterial results which were slightly lower than the required

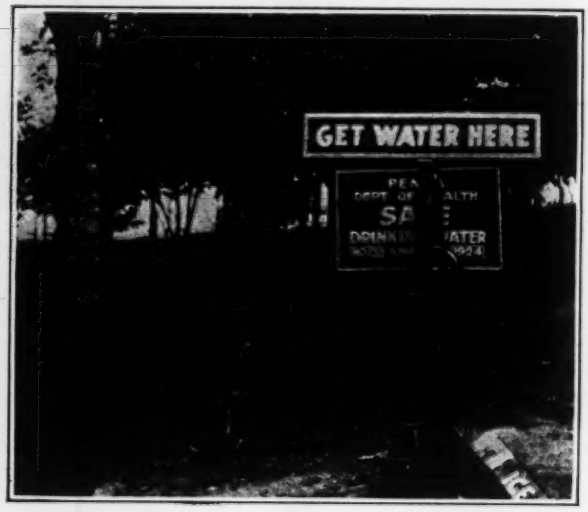


FIG. 3—OWNERS USED THE APPROVAL TO LURE TOURISTS

Official placard is on tree but this enterprising owner has utilized the full advertising value by making an enlarged fac-simile.

standards. No action was taken on certain sources of supply, usually for the reason that these sources had been recently developed and the poor bacterial results obtained were considered to be due to temporary contamination incident to construction.

Of the 685 placarded safe or disapproved wells, 275 were dug wells, 248 drilled wells and 162 springs, runs or cisterns. Of the 275 dug wells examined, 104, or 38 per cent, were approved and 62 per cent disapproved. Of the 248 drilled wells examined, 199 or 80 per cent were approved and 20 per cent disapproved. Of the 162 springs, etc., examined, 104, or 65 per cent, were approved and 35 per cent disapproved. A study of the supplies condemned shows that over 75 per cent of those not approved were in limestone and broken shale formation, while only 13 per cent approved were in limestone or broken shale formation. When it is borne in mind that all of the 685 sources were selected supplies having satisfactory surface conditions and showing no evident signs of contamination, it is apparent that the geologic structure was the determining factor in most cases as to the safety of the supply. In many cases a surface supply or shallow spring not in limestone formation was found to be safe, while such a spring in a limestone formation was found to be unsafe. The same condition obtains in the deep wells.

Owing to the fact that the work was started rather late in the season and it was desired to cover the entire state, the principal object was to locate sources of safe drinking water. The improvement of unsatisfactory sources of supply was considered of secondary importance during the first survey. As a matter of fact many owners of sources of supply which were not approved have sought advice from the Department of Health, and are trying to effect improvements which will insure their supplies being approved on the next survey. It is the intention of the department to continue this project during the summer of 1925. All sources of highway water supply will be re-examined and re-tested before approval signs for 1925 are granted.

Lake Erie-Ohio River Canal Reported on Unfavorably

AN UNFAVORABLE report upon the proposed canal connecting Lake Erie with the Ohio River has been made to the Board of Engineers for Rivers and Harbors by the division engineer of the Central Division, Corps of Engineers, U. S. Army, according to a notice issued to parties interested in the proposed canal by Col. C. W. Kutz, division engineer. Details of the report will not be made public until after it has been presented to Congress, but the notice states that the adverse conclusions are based on economic considerations as all three routes studied are feasible from an engineering standpoint. The report recites:

"The route extending from Portsmouth, Ohio, to Sandusky, Ohio, and the route extending from Cincinnati, Ohio, to Toledo, are both found to be economically inadvisable in that the fixed charges on such waterways will greatly exceed the prospective benefits; the latter having been computed by taking the differences between canal haulage costs and existing rail rates and applying them to the prospective commerce.

"As to the route extending from Beaver, Pa., to Ashtabula, Ohio, an economic comparison similar to the one just described shows that such a canal, when operating at capacity, will yield benefits approximately equal to the fixed charges but that if certain inequities and inequalities in the existing rail rate structure on competing rail routes are eliminated and rail rates on low grade bulk commodities on such rail routes made reasonably proportional to the cost of the service, the direct benefits will be substantially less than the fixed charges.

"As a rail rate case, seeking the elimination of some of these inequalities, is now pending before the Interstate Commerce Commission, the conclusion has been reached that a canal along the Beaver-Ashtabula Route is also economically inadvisable.

"*French Creek Route*—Supplementary to the legislation authorizing the above report, the River and Harbor act approved Sept. 22, 1922, provided for a preliminary examination and report on a waterway from a point at or near Erie Harbor, Pa., by way of French Creek and Allegheny River, to the Ohio River.

"The report thereon has been made and is unfavorable to the improvement. This adverse conclusion was based on a study of existing maps and data which

showed that such a waterway would be longer, require greater lockage, and be far less valuable as a transportation route for through commerce between Lake Erie and the Ohio River than a waterway of the same size built along the Beaver-Mahoning Route (synonymous with Beaver-Mahoning River)."

Interested parties are given the privilege of an appeal from this conclusion to the Board of Engineers for Rivers and Harbors within four weeks from the date of the publication of the notice of the adverse report.

Ford Company Develops and Uses Power at High Dam

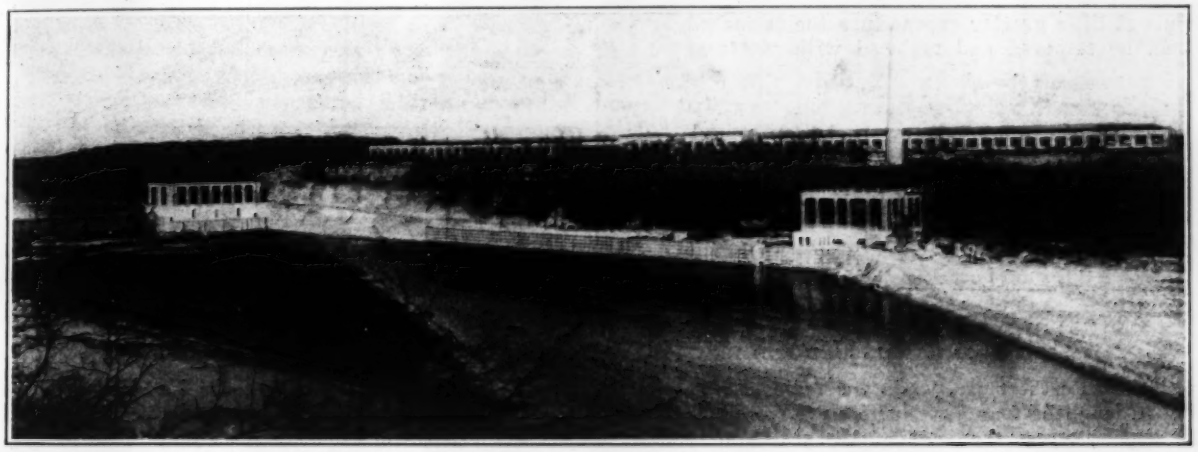
Manufacturing Plant Built at Dam with Rail and Water Facilities—Steam Plant Supplements Water Power

AT HIGH DAM on the Mississippi River in St. Paul, Minn., the Ford Motor Co. has built a large manufacturing plant to be supplied with power from a hydro-electric generating station making use of the water power available at the dam and supplemented by a steam-electric generating station. High Dam was completed by the government in 1917 after earlier plans for two dams with locks in the river at this point had been abandoned in favor of one set of locks and one dam in order to develop the full head of 31½ ft. with an output of about 24,000 horsepower. The substructure for a four-unit power house was built in the dam but no attempt was made to develop the power until the site was leased recently to the Ford Motor Co. When the new power house was built it was necessary to cut away the greater part of the concrete in the substructure built by the government in order to make way for new draft tubes adapted to the developments in design since the substructure was built.

On a tract of land of approximately 160 acres the company has built a manufacturing plant with a main building 1,400 ft. long and 600 ft. wide and on the river bank below the dam a steam-electric generating plant as an auxiliary to the hydro-electric plant. The general layout is shown in the accompanying illustration. The hydro-electric plant contains four units of 4,500 kw. each and the steam plant contains one unit of 5,000 kw. with provisions for a second unit. This plant will also furnish steam heat for all the buildings.

Railroad connections for the manufacturing plant are provided through two depressed tracks running the full length of the building and one coal track running along the outside, all three tracks connected to the C. M. & St. P. Ry. Access to the navigable channel of the Mississippi River is provided by means of a quay along the river bank between the two power houses in a situation where the flow of tail water from the hydro-electric plant will insure an open channel. A pair of tunnels 10 ft. wide and 11 ft. high extend back into the bluff and under the manufacturing plant to give direct access from the plant to the water terminal.

The construction was carried on by Stone & Webster. About 600 men were employed on the power houses and 500 on the manufacturing plant. The hydro-electric plant was ready to generate power in July and, pending the completion of the manufacturing plant, the power available was generated and sold in compliance with the terms of the lease which call for the generation of all the power available at the site and the sale to outside companies of all power not used in the manufacturing plant.



FORD MOTOR CO. MANUFACTURING PLANT AND POWER HOUSES, ST. PAUL, MINN.

South Australia Adopts American Methods

American railway methods are being applied to the South Australian railways under the direction of Chief Railway Commissioner W. A. Webb, former vice-president and general manager of the M.-K.-T. R.R., who was engaged from America by the Barwell government in 1923 to take charge of the railways. Several million pounds are being spent in relaying portions of existing lines with 80-lb. rails, strengthening existing structures to carry heavier loadings, providing more engines of the Mountain and Pacific type, providing steel passenger cars and 40-ton freight cars and generally bringing the railways of South Australia in line with modern standard practice. New structures include coaling plants of types similar to modern ones in the United States and having capacities ranging from 150 to 300 tons. All-electric signaling is being extended from Adelaide north and south along the main arteries. A feature of the reorganization has been the introduction of rail motor cars built in America for use generally for branch lines and feeders to main lines.

Old Steel Trainshed Replaced by Platform Shelters

Lofty Truss Roof Dismantled After 32 Years' Service on Account of Maintenance Cost Due to Corrosion

REMOVAL of the old steel trainshed of the Union Station at Duluth, Minn., and its replacement with platform shelters, marks the gradual disappearance of this old type of lofty long-span structures. This trainshed, 130-ft. span c. to c. of end pins and 400 ft. long, was built in 1892 and during the past ten years it has required large expenditures for maintenance. Smoke and gases from the engines caused corrosion of some of the metal directly beneath the skylights, and the structure was maintained in condition by placing wooden members as substitutes for some of the metalwork supporting the glass.

An examination made in 1924 showed that it would be necessary to spend $15,000 to $20,000 in the removal of purlins, skylights and louvres, while at little greater expenditure the trainshed could be removed and replaced with platform shelters. Furthermore, while the trainshed was only 400 ft. long, the four new shelters are from 400 to 875 ft. long. Across the ends of the tracks is a 25-ft. covered transverse platform connecting with the headhouse. Each shelter consists of a row of steel columns spaced 20 ft. c. to c. and having 17-ft. T-heads carrying wood joists for a 21-ft. plank roof of the butterfly type, with central gutter and downspouts. The plank sheathing of the shelter roof is covered with tar and gravel roofing.

For reasons of safety and convenience, the work of dismantling the trainshed was done only between 11:30 p.m. and 6 a.m., since no trains enter or leave the station during this period. The contractor used two locomotive cranes having booms of sufficient length to support a truss from the top chord, the ends being burned off while it was held in this position. Then the truss was lowered to the ground and cut by torches into pieces of sufficient length to be loaded onto cars. All equipment and salvage material was removed from the station platform each night, so that there was no interference with the use of the station. After the removal of the skylights, roofing and sheathing, about

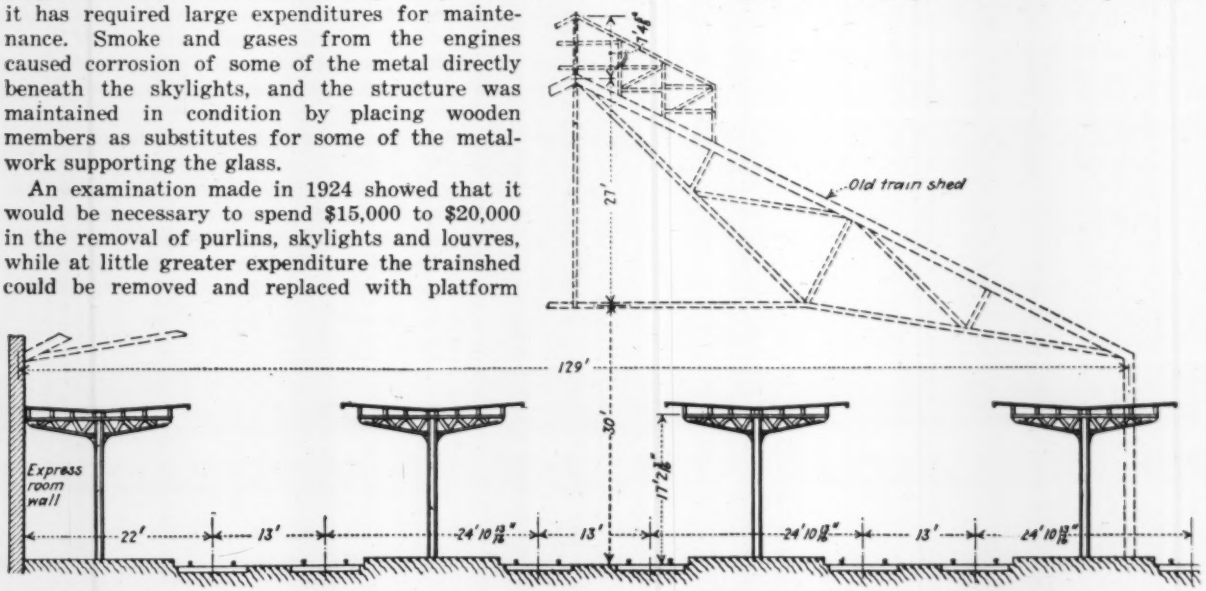


FIG. 2—OLD TRAINSHED AND NEW PLATFORM SHELTERS AT DULUTH UNION STATION

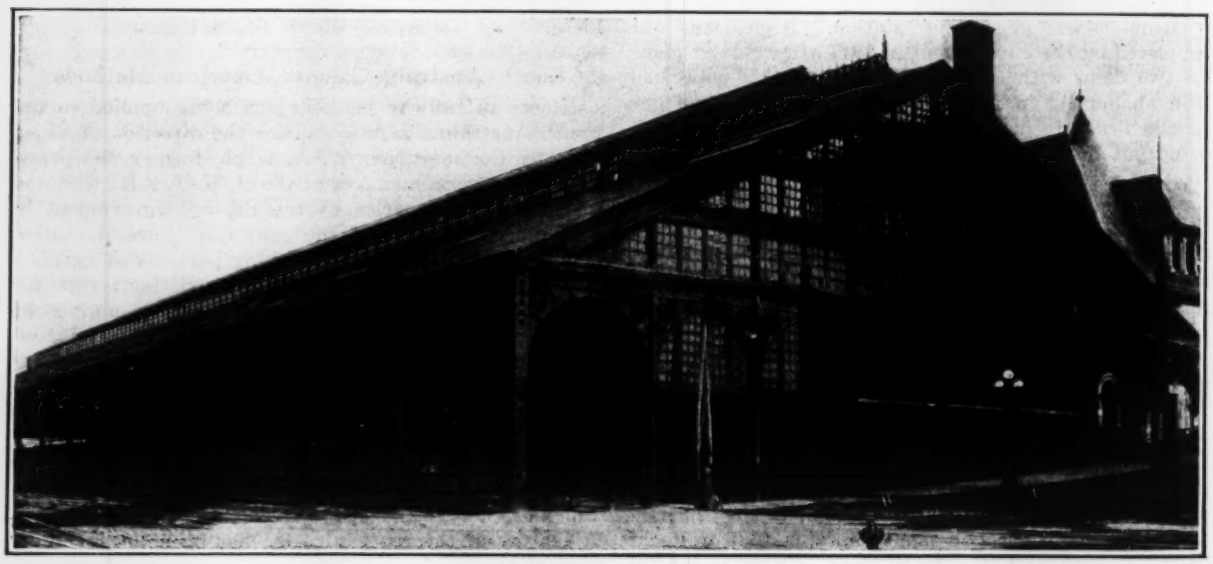


FIG. 1—STEEL TRAINSHED AT UNION STATION, DULUTH, MINN.
This trainshed was built in 1892 and was taken down in 1924 and replaced with platform shelters.

six days' work was required to take down the trusses and all steelwork.

In connection with this alteration, there was a general relocation of tracks in the station and yard, together with laying 90-lb. rails and stone ballast.

The total cost of all the work was about $100,000. After the removal of the roofing by M. J. Harney, Duluth, the trainshed was taken down by Peppard & Fulton, Superior, Wis. This improvement was planned and carried out under the direction of H. E. Stevens, chief engineer, Northern Pacific Railway.

Effect of Flowing Water on the Stability of Sand

Experiments in Filter Bed and Observations on Dikes, Cofferdams, and Jetting Piles for Water Intake at St. Louis, Mo.

By C. M. Daily

Division Engineer, Supply and Purifying Section, Water Division, St. Louis, Mo.

THE flow of water through sand may produce a hard compact mass or it may cause the sand to lose its resistance to lateral movement or it may cause any intermediate state, depending entirely upon the direction and velocity of the water. A downward flow of water through sand makes it compact and an upward flow causes it to become mobile. The upward velocity required to cause water to lose its resistance to lateral movement depends upon the size of the sand grains and the amount and character of the foreign material in it.

Some experiments were made last winter in one of the filter beds, in St. Louis, Mo., to determine the upward velocity of the water through the sand at which the sand bed would fail to support a weight of 24 lb. over an area of 6 sq.in. and allow the weight to sink to the gravel. The sand varied from 0.38 to 1.2 mm. in size and was 27 in. deep. The upward velocity of the water, considered over the entire area, was about 0.09 ft., per minute. A downward flow of the same velocity caused the sand to become firm and the same 24-lb. weight would not make a depression in it.

Extensive data on this subject would be very useful in designing dikes to be constructed in sandy rivers like the Mississippi and Missouri and for such cases as the construction of cofferdams, the jetting of piles and the many kindred operations.

It is a well recognized fact that a permeable dike in the Missouri River is liable to fail if the water on the upstream side has a head of about 1 ft. or more above that on the downstream side. The cause of such a failure is not as fully recognized, judging from the lack of precautionary measures embodied in their design. The failures are caused primarily by water rising through the sand below the dike, in each case causing the sand to lose its resistance to lateral movement; the pressure of the water above the dike completes the failure. Two measures may be used in some cases to overcome the difficulty, but neither of them may be practical in other cases. The first is to reduce the head on each dike by building several close together rather than a few far apart, and the second is to prevent water from penetrating the sand above the dike.

In December, 1924, the water was lowered 2½ ft. below the river level in a cellular cofferdam around the site of the water-works intake and low-service pump pit for our Missouri River plant, for convenience in dredging. An inward movement of the cells immediately took place. The water was then raised 1½ ft. above the river level and all movement ceased. This incident impressed one with the necessity of controlling the flow of water into or out of a cofferdam to obtain the degree of stability required.

The jetting of piles depends on the upward flow of water through the sand around the pile and not entirely, as might be supposed, upon a jet action near the point of the pile. The quantity of water required to jet a pile in the ground depends on the character of the material encountered and the proximity to piles previously jetted which may provide a path of low resistance to water moving upward. The ideal jet for sinking piles in alluvial soil is one that will insure a column of sand in suspension, or quicksand, around the pile. To obtain this, in many cases, it is advisable to allow water to escape from the sides of the jet pipe at close intervals and in sufficient quantities to maintain a column of sand in suspension around the pile which will offer a channel of least resistance for the upward flow of water which escapes at the lower end of the jet pipe. When this mobile condition of sand exists around a pile, it may easily be forced to any depth. The churning of a jet pipe, so common and seemingly so necessary in jetting a pile into the ground, causes only the same condition of lowered resistance to upward flow of water around the pile that frequent side jets produce.

In jetting 48-ft. reinforced-concrete bearing piles 16½ in. square for the intake and low-service pump pit for our Missouri River plant, the Frazier-Davis Construction Co. used from 600 to 900 gal. of water per minute through a 4-in. jet pipe having 2-in. nozzle. No side jets have been used to date but difficulties on several occasions were experienced in getting the piles to rock.

State Settlement Proposed for North Dakota

State promotion of land settlement is recommended by the state engineer of North Dakota in his annual report, just issued. Irrigation is developing slowly in the state, and "the settlement of land is perhaps the most difficult problem faced by the U. S. Reclamation Service on the projects already developed" in the state. Proper control of settlement was not possible because most of the land was in private ownership, and as the holders attempted to farm excessive areas many failures resulted. Adequate settlement is the greatest need of all irrigation projects in the state, and it is realized that until present projects show good results it will be difficult to obtain further funds for reclamation. On this account, says the state engineer, W. G. Black, "it should be to the interest of the state to encourage the settlement of the land in as small tracts as possible. It is recommended that land settlement schemes such as are now being applied on irrigation projects in several western states be studied. The settlement plan of California in particular is recommended . . . . . Irrigation in North Dakota should be considered as a new industry that will serve to supplement the type of farming heretofore practised by supplying food products not obtainable by any other means."

From the Water-Works Field

Solving Every-Day Water-Works Problems of Cities and Towns

New Type of Chlorinating Apparatus at Albany Water-Works

Control Valve, Pressure Gage, U-Tube Manometer and Rate-of-Flow Chart Based on Pressure Loss and Density of Gas

By Theodore Horton
Chief Sanitary Engineer, Department of State Engineer, and Formerly Chief Engineer State Department of Health, Albany, N. Y.

THOSE concerned in the chlorination of water and sewage will probably find interest in a new apparatus of recent design, which has just been installed for the chlorination of the water supply of Albany, N. Y. The apparatus is the outgrowth of experiments carried out by the writer in an effort to develop an inexpensive instrument of simple design and construction, i.e., one less liable to get out of order and less troublesome to maintain than any hitherto developed.

The apparatus is essentially a gas meter comprising four essential parts: A control valve, a pressure gage, a manometer and a rate-of-flow chart. The principle upon which the instrument operates is a co-ordination of the loss of pressure resulting from a flow of gas through a short tube with the density of the gas.

It is a well-known fact that the laws governing the flow of gases through pipes or tubes are closely similar to the laws for the flow of water through pipes or conduits. The only factor of importance which causes a variation in this similarity is that of density. Thus, with water the frictional loss of head due to uniform flow through a pipe of given diameter will increase with the velocity and be independent of the water pressure. The same is substantially true with a gas except that the greater the pressure of the gas the

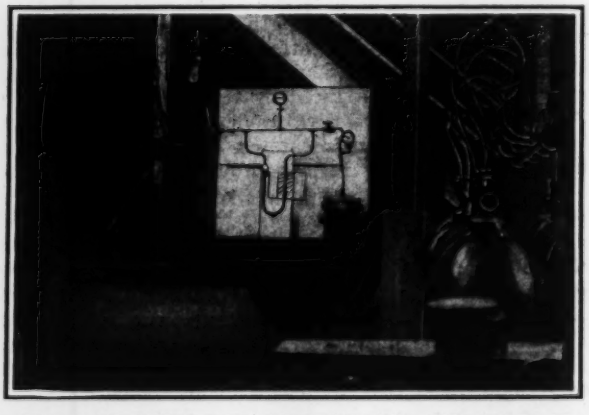


FIG. 1—NEW TYPE OF CHLORINATOR, ALBANY, N. Y.

greater will be the density. The quantity by weight of such a gas flowing through such a pipe will therefore depend not only upon the velocity of flow but also upon its density. It is obvious therefore that by bringing these two factors, frictional loss of head and density, into mechanical combination with a chart or scale, as in the apparatus recently installed in Albany, a direct measurement of the quantity of the gas flowing through

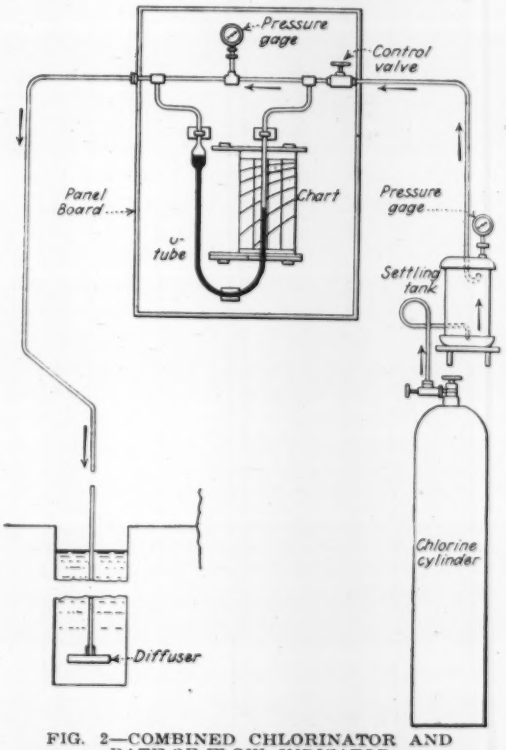


FIG. 2—COMBINED CHLORINATOR AND RATE-OF-FLOW INDICATOR

The upper pressure gage registers the average pressure (density) of the gas. The bulb at the top of the U-tube maintains the liquid in the left leg at a practically constant level when the liquid in the right leg is depressed. By sliding, along the horizontal guides, the glass or wood plate on which the chart is mounted the observer brings the vertical lines corresponding to the upper pressure gage opposite the right leg of the U-tube, then reads the volume of gas flow from the position of the meniscus with reference to the curved lines. Similarly, the opening of the control valve to give the desired volume rate of gas flow is controlled. Once set, little if any further adjustment is required, except to meet (1) temperature changes or (2) depletion of gas in the cylinders, or (3) to establish a new dosing rate. Experience shows that changes in temperature need give little concern, while the replacement of cylinders can be so ordered as to reduce to a minimum the variations in pressure on the score of depleted pressure.

the apparatus per hour, or per day, as may be desired, is obtained.

Fig. 1 shows the instrument installed at Albany. Fig. 2 and its sub-caption illustrate and explain the design and operation of the apparatus.

The present apparatus eliminates entirely the need of a compensating valve, and the use of a check valve is not considered at all necessary by the designer. It is true that if the instrument is shut down water will be drawn back a slight distance into the tube, due to absorption of the gas. The height to which it is drawn is, however, ordinarily not over 3 or 4 ft. and for the obvious reason that as the water is drawn back into the tube, that portion on top of the column of water

becomes saturated (the saturation point being only a few per cent), so that equilibrium is soon established with only a slight rise of the liquid. If the instrument is placed in a low position with reference to the level of the diffuser, it is a very simple matter to run the discharge tube up a short distance above the instrument before leading it downward to the diffuser, thus forming a trap which would prevent the water from being drawn back into the apparatus.

Two of these chlorinators are now in use in the city of Albany. One, used for pre-chlorinating the general supply, was first put in service on Sept. 26, 1924. Except for two brief periods, one awaiting the receipt of silver tubing to replace the rubber tubing temporarily used on the discharge line and the other awaiting chlorine shipment, this apparatus has been in continuous use, applying chlorine at a rate of from 200 to 250 lb. per day. The other apparatus was installed on Feb. 11, 1925, and is now chlorinating the supply from Rensselaer Lake, a temporary source used only during the winter months. Both installations are running smoothly and with perfect satisfaction, requiring almost no adjustment or other attention except replacement of chlorine cylinders.

The apparatus, in conjunction with the chart, is covered by U. S. Patent No. 1,423,217, granted to the author July 18, 1922.

Fire Hose Forms Seal for Stop Logs to Unwater Intake Chamber

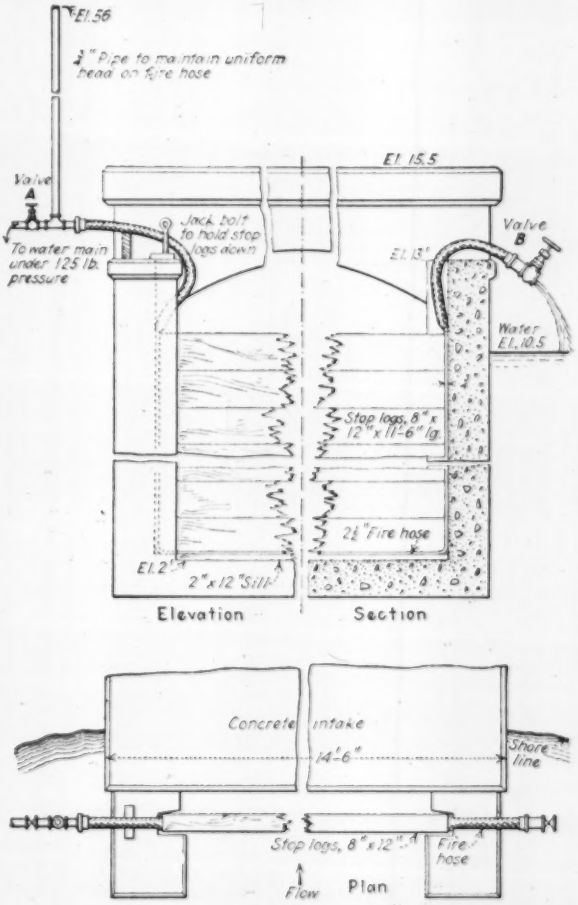
By J. E. Gibson
Manager and Engineer, Water Department, Charleston, S. C.

During the recent construction of a water-supply intake at the shore line of the Goose Creek storage reservoir of the water-works of Charleston, S. C., it was necessary to unwater the new intake chamber to permit making the connection of the old and the new intake pipes. In the construction, provision had been made for placing stop logs in the concrete intake channel from the reservoir. When the time came to place these stop logs in position and unwater the chamber, the leakage around the ends of the stop logs was greatly in excess of the capacity of the three 2-in. steam ejectors that had been used to unwater the cofferdam at the time of placing the concrete. In other words, sufficient difference in head could not be obtained to cause the outward pressure to seat the stop logs effectually against the sides of the groove in the concrete, although by means of the jack bolts the horizontal joints between the logs themselves could be effectually sealed.

It was objectionable to attempt to seal these leaks by placing cinders or other material in the intake channel as it was thought that this material would be carried through and might ultimately reach the pumps.

The method finally adopted, which we considered unique, was to remove all of the logs, shape the lower end of the bottom log to a gentle radius and fasten to it by means of strips of canvas a piece of standard 2½-in. fire hose, allowing sufficient hose to extend beyond each end of the log to reach above the surface of the water when the bottom log was in final position, placing the log back in the groove or slot in the intake channel; then placing successively the remaining logs, forcing them to the bottom of the groove or slot until sufficient logs had been placed to extend above the flow line of the storage reservoir. The stop logs had been cut short enough to make room in the slots for the collapsed fire hose.

After all necessary stop logs were in position and forced to their seats by the jack bolts, a ¾-in. water pipe was connected to the inlet end of the hose. On the opposite end of the hose a standard hose valve was placed and allowed to remain open to vent the air



FIRE HOSE UNDER UNIFORM HEAD SEALS STOP LOGS AT ENTRANCE TO CONCRETE WATER-WORKS INTAKE

and to permit a circulation of water completely through the section around the stop logs. To prevent excessive pressure, and to maintain a uniform head in the hose, a section of ¾-in. pipe was run up alongside a tree to an elevation about 45 ft. above the flow line of the reservoir. The valve *A* (see illustration) was cracked sufficiently to keep this pipe overflowing. Water was allowed to circulate continuously through the hose and escaped through the valve *B* to give the foreman a visual assurance that he was maintaining the supply of water in the hose and, further, to prevent freezing in the exposed sections. It will be seen that an excessive pressure in the hose would have acted the same as a hydraulic jack and might have ruptured the concrete abutments. It was reasoned that a 45-ft. head would not do this.

After everything was in place and the water was turned on, the leakage was reduced so that one 2-in. steam ejector running about three hours per day would take care of the leakage through and around the stop

logs. There was a total of 192 ft. of joint between the individual logs and the ends of the intake. This was maintained for about three months as other difficulties prevented the completion of connections to the old intake line.

Upon removal of the hose, it was found that the mildew had practically ruined it, but on the whole we considered it a good job and a satisfactory method of stopping the leakage.

F. B. McDowell, assistant manager and engineer of the Charleston Water Department, was responsible for the suggestion and its successful use.

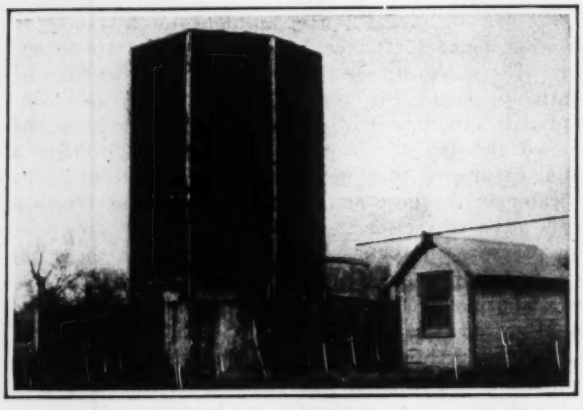
Water-Works Problems in a Town of 1,000 People

Aerating Tower to Eliminate Odors—Superintendent Reverses Filter Flow and Throws Away Alum Apparatus

By Harry P. Letton
Of Grant, Smith & Letton, Consulting Engineers, Lincoln, Neb.

A SIMPLE aerating tower constructed for the purpose of removing tastes and odors from a public water supply in Weeping Water, Neb., has proved so successful that it is believed a similar structure might be used with benefit in other places where odor troubles are encountered. Experience of this town of 1,000 people with a superintendent who discarded the filter sand, reversed the flow in a pressure filter and junked the alum rig indicate the vicissitudes small towns without intelligent operation occasionally endure.

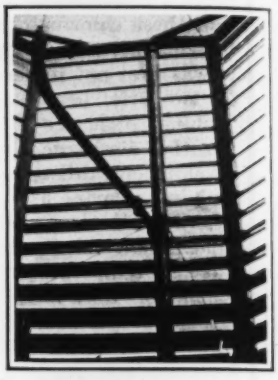
The water supply was formerly obtained from shallow wells along the bank of Weeping Water Creek. This supply proving inadequate some years ago, a 4-in. cast-iron pipe line was run from the pumping station to an ice pond 900 ft. away. This pond, which covers not over four acres to an average depth of 5 ft., is kept full by diverting water from the creek whenever required. The creek, which is a spring-fed stream, has a small dry-weather flow and becomes extremely turbid during rains. At the time the line to the pond was constructed, a pressure filter having a rated capacity of 180,000 gal. per day was installed. The filter did not remove the turbidity satisfactorily and accordingly the town constructed a circular sedimentation basin with a spiral baffle wall so arranged that the raw water entered at the center and passed spirally through the tank.



AERATING TOWER, COAGULATION BASIN AND LOW-LIFT PUMP HOUSE

Solving the Every-Day

In 1922 the writer's firm was employed to advise the city on the water situation. At this time no appreciable difference was noted between the pond water and the water delivered at the taps. Investigation disclosed the fact that although the filter and sedimentation basin were large enough under proper operation to treat the water successfully, no apparent improvement was effected. On opening the filter it was found that the water superintendent had removed all the filter sand, replaced it with 2 ft. of coarse gravel and charcoal and had punched holes in the tops of the strainers. He had also changed the filter piping and was pumping the water backward through the strainers and up through the gravel and charcoal into the distribution system. The result of this practice was that the filter became an incubator; the bacterial count increased rather than decreased. No coagulant had been used although the necessary equipment was found in a junk heap in the attic of the pumping station.



INSIDE OF AERATING TOWER NEAR TOP

New strainers were obtained for the filter, properly graded filter sand and gravel were replaced and the filter piping put back. Alum tanks and an orifice box were installed for coagulating purposes and a chlorinator for sterilizing the supply.

As the elevation of the water in the pond was less than a foot above the coagulation basin walls it was impossible to obtain sufficient flow by gravity. A second-hand, belt-driven centrifugal pump had been installed, previous to this investigation, in a small building alongside the basin. This pump took its suction from the 4-in. line and discharged into a home-made aerator in the center of the basin. As soon as the changes outlined had been made, a pure, clear, sparkling water was obtained, but it was necessary to run the high-lift pump intermittently because of the fact that the pump feeding the basin had a smaller capacity than the triplex pump which forced the water through the filter and into the distribution system of the town. This arrangement required the coagulation basin to operate partially on a fill-and-draw principle.

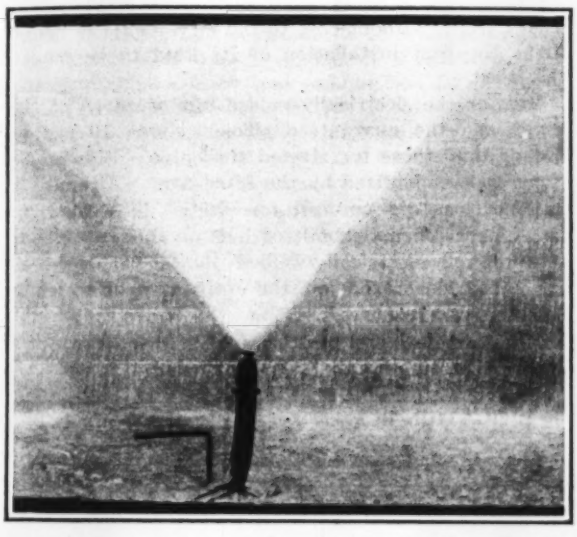
Although the water was perfectly clear it had a disagreeable taste and odor due to the presence of green growths. Treatment of the pond with copper sulphate was not sufficient to overcome the odors, and it was therefore decided to construct a more efficient aerating device. A new motor-driven centrifugal pump capable of delivering over 200,000 gal. per day against a total head of 50 ft. was obtained and installed in the place of the old pump.

The discharge from this pump was connected to a 4-in. riser on which were three lateral 2-in. branches spaced 5 ft. apart. The ends of the lateral pipes were bent up on a 1-ft. radius and on each was placed a spray nozzle of the type used in cooling ponds. These nozzles

Water-Works Problems

have ¾-in. orifices and each of them will deliver about 45 gal. per minute under a pressure of 8 lb. The riser pipe was located so that the nozzles were directly over the center of the basin.

Around the nozzles as a center was constructed an octagonal-shaped open-work tower having a diameter of about 30 ft. Each corner of the tower was formed by a 6 x 8-in. timber bolted to the baffle wall in the sedimentation basin. Between the uprights were nailed louvres sawed from 1 x 12-in. lumber and spaced in such a manner as to prevent spray from the nozzles from passing between the louvres. The top of the tower was



BOTTOM NOZZLE OF AERATING TOWER IN ACTION
Looking into the tower through opening formed by removing some of the louvres.

framed and braced with 2 x 6-in. timber and the whole was tied together by means of iron rods. The lowest nozzle was placed just above the baffle wall and the area within the tower was floored so as to collect the water falling from the sprays and louvres. The floor was sloped to discharge this water into the center of the basin. Valves were placed on each of the lateral spray pipes so that the pressure in each might be regulated to distribute the water equally. A bypass valve was placed on the riser below the surface of the water in the basin so that during the winter months when aeration was not required the pond water could be pumped directly into the basin without danger of freezing.

The entire cost of the installation described, including the pump, was less than $800. The system was successful in eliminating odors in the summer of 1924.

Users Advance Money for Small-Town Water Extensions

By Jent G. Thorne
Consulting Engineer, Clinton, Iowa

THE town of Low Moor, Iowa, being confronted with the necessity of providing more water mains, after all legal means of increasing the town's bond issue were exhausted, appealed to the interested property owners for aid. These property owners asked permission to subscribe certain amounts of money to be used to pay for the desired mains provided that the town would grant them credit on future water bills at the regular rate. A majority of property owners subscribed $100 each and a few larger amounts. Figured at the rate of $20 a year the average consumer would use up his credit in five years time and the water mains would then belong to the town.

Five blocks of water mains were laid and financed in this manner. The town was willing to supply the water as the number of consumers was so small that water was being wasted to keep a fresh supply in the tank, The property owners feel that they have a good bargain and the town officials are gratified to have the additional mains installed ready for use. Petitions are now in circulation for the laying of more mains by the same method.

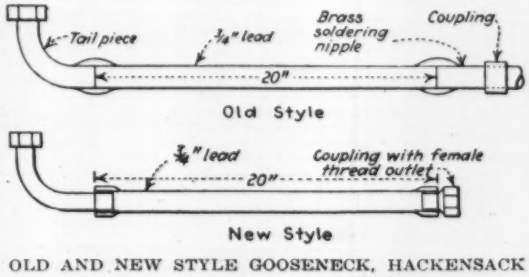
Brass Services and Special Goosenecks Used by Hackensack Water Co.

By D. W. French
Superintendent, Hackensack Water Co., Weehawken, N. J.

BRASS service pipes and lead goosenecks with cupped joints are now being used by the Hackensack Water Co. which supplies some fifty New Jersey towns and villages on and near the Hudson and Hackensack Rivers. The goosenecks are made in the company's shop, at a saving of 80c. each compared with the wiped joint goosenecks formerly made by plumbers.

The use of brass services was begun by the company about three years ago on all of its house service installation work between the street main and the curb, and also in renewals of old services which had failed. The smallest size used is ¾-in. but for 1-in. work brass pipe is also used. For sizes larger than 1-in., cast-iron is used exclusively. When we first started this work we used the regular brass pipe, I.P.S. (iron pipe size). It gave us some trouble on account of its being too hard and brittle and being non-flexible so that it broke transversely much as would a glass tube. In the next purchase semi-annealed pipe was specified and with this quality no trouble has developed.

Before purchasing pipe for this year's work (1925) I obtained from Mr. Schneider, representing the Copper & Brass Research Association of New York City, a copy of a specification prepared by the American Society for Testing Materials covering brass service pipe requirements and asked for bids for 135,000 ft. in January. Part of the pipe has been received and is being used. The pipe is I.P.S., is very flexible, threads and cuts well and comes in 12-ft. lengths. I fully believe it will meet requirements in every way.



OLD AND NEW STYLE GOOSENECK, HACKENSACK

Brass pipe may not be quite as cheap as lead-lined galvanized iron, galvanized iron or black, but the following figures show that it is less costly than lead of

the same size: ¾-in. lead AA weighs 3½ lb. per ft. and with lead pipe at 10c. per lb. the cost is 35c. per ft.; ¾ in. brass weighs 1¼ lb. per ft. and costs 18⅜c. per lb. or 23c. per foot.

We are using a lead gooseneck between the corporation tap and the point where the brass pipe begins. Until Jan. 1 of this year, these goosenecks were made up by local plumbers, the 90-deg. tail piece of the corporation tap and a brass soldering nipple at the other end of a piece of lead pipe 20 in. long having wiped joints. These goosenecks were expensive, frequently leaked and were generally unsatisfactory. Our master mechanic, Hugh Davis, suggested doing away with the wiped joints and making cup joints instead. This is done by driving a former into the ends of a piece of lead pipe and soldering in the tail piece at one end and a special coupling at the other, leaving when finished a female thread to receive the pipe. No soldering nipple is used. We are now making these in our own shop for about 80c. apiece less than the old style and each completed piece is tested to 300 lb. pressure before going into stock. They are exceedingly satisfactory.

Standard Report Sheets for Small Filters

TO assist the smaller filter plants in Illinois in keeping their daily records so that standard, comparable monthly reports may be made to the State Board of Health, Harry F. Ferguson, state sanitary engineer, has had a blank form for recording daily results printed. The forms are supplied at cost. One of them is reproduced herewith.

Solving the Every-Day

Electrically-Welded Steel Pipe Line for Vallejo Water-Works

THE city of Vallejo, Calif., on March 18, awarded a contract to the Western Pipe & Steel Co. for 22 miles of electrically-welded steel pipe which is to bring water from Gordon Valley, where a new storage reservoir is being built, to the city distribution system. The manufacturers, who are to install the line, have placed themselves under a $200,000 surety bond, guaranteeing the pipe for a period of five years against all leaks and other defects due to faulty material, manufacture or installation, and agreeing to make good or replace any such defects without cost to the city. This is believed to be the first installation of its kind to be made in the West.

Bids on the electrically-welded pipe were 10 per cent lower and the guaranteed efficiency was 10 per cent higher than those for riveted steel pipe. Bids on both types were submitted by the same firm. Although the specifications did not call for electrically-welded pipe, two separate firms submitted bids on this type. Adoption of the electrically-welded joints saved the city about $40,000 on the job, the entire cost of which will be about $450,000.

The diameters will be 22 and 24 in., the length of the sections 14 ft. and the plate thicknesses ⅜ and ¼ in.

Form prepared by Division of Sanitary Engineering (Issue 1918) Department of Public Health

Daily report sheets to be kept on binder and preserved

WATER PURIFICATION PLANT

OPERATION REPORT FOR _____ (Month) _____ (Day) 192____

LOW-SERVICE PUMPS									COAGULATION BASIN STAGE		HIGH-SERVICE PUMPS									CLEAR WELL STAGE	
NO. PUMP			NO. PUMP			NO. PUMP					NO. PUMP			NO. PUMP			NO. PUMP				
On	Off	Pumpage 1000 Gal.	On	Off	Pumpage 1000 Gal.	On	Off	Pumpage 1000 Gal.	Pump On	Pump Off	On	Off	Pumpage 1000 Gal.	On	Off	Pumpage 1000 Gal.	On	Off	Pumpage 1000 Gal.	Time	Stage

FILTER OPERATING DATA

Filter No.	On	Off	Length run (hours)	Average rate	Amount filtered 1000 Gal.	LOSS-OF-HEAD Start	LOSS-OF-HEAD End	Minutes	WASH Rate	WASH Amount 1000 Gal.	Filter No.	On	Off	Length run (hours)	Average rate	Amount filtered 1000 Gal.	LOSS-OF-HEAD Start	LOSS-OF-HEAD End	Minutes	WASH Rate	WASH Amount 1000 Gal.

CHLORINE

NO. 1 CHLORINATOR On	NO. 1 CHLORINATOR Off	NO. 1 CHLORINATOR Puls. per minute or lbs. per 24 hrs.	No. 2 CHLORINATOR On	No. 2 CHLORINATOR Off	No. 2 CHLORINATOR Puls. per minute or lbs. per 24 hrs.	DOSE Pounds per mil. gal.

WEIGHT OF CYLINDERS Time	WEIGHT OF CYLINDERS Weight	WEIGHT OF CYLINDERS Lbs. used	WEIGHT OF CYLINDERS Time	WEIGHT OF CYLINDERS Weight	WEIGHT OF CYLINDERS Lbs. used	TOTAL CHLORINE USED

TURBIDITY Time	TURBIDITY Raw	TURBIDITY Settled	TURBIDITY Filt.	ALKALINITY Time	ALKALINITY Raw	ALKALINITY Filt.

ALUM

COAGULANT DOSAGE NO. 1 TANK On	NO. 1 TANK Off	NO. 1 TANK Lbs. used	NO. 2 TANK On	NO. 2 TANK Off	NO. 2 TANK Lbs. used	Orifice Setting	Grains per Gallon

LIME

GAS FORMERS TIME	M	PRESUMPTIVE 24 Hrs.	PRESUMPTIVE 48 Hrs.	PARTIAL CONFIRM	CONFIRM	BACTERIA PER C. C.
Raw or Settled						
Filtered No.						
Filtered No.						
Filtered No.						
Sterilized						

TIME	RESID. CL. LAB. TAP	RESID. CL. DIST. SYSTEM	pH or Co_2 RAW	pH or Co_2 FILT.	ODOR RAW	ODOR FILT.

POUNDS ALUM USED _____
AVERAGE DOSE (GR. PER GAL.) _____
POUNDS LIME USED _____
AVERAGE DOSE (GR. PER GAL.) _____
POUNDS CHLORINE USED _____
AVERAGE DOSE (LBS. PER MIL. GAL.) _____

LOW-LIFT PUMPAGE _____ Gals.
HIGH-LIFT PUMPAGE _____ Gals.
WASH WATER USED _____ Gals.
PER CENT WASH WATER _____ %

CHIEF OPERATOR OR SUPERINTENDENT

FORM FOR SMALL FILTER PLANT DAILY RECORDS, SUPPLIED BY ILLINOIS STATE DEPARTMENT OF HEALTH
The original sheets are 8½x11 in. There are 10 lines for pump records and 18 lines for results of individual filters.

Water-Works Problems

The sections are to be dipped and wrapped. The estimated life of the pipe is 35 to 40 years. For a third of its length the pipe line will be under a head of about 400 ft., the remainder will be under heads ranging down to a minimum of 100 ft. Each section is to be tested in the shop to a pressure of 225 lb. per sq.in. and after installation the completed line is to be subjected to a test of 200 lb. per sq.in. for 48 hours.

In the manufacture of this pipe the longitudinal seams are all made by the full automatic process, using direct current, and are guaranteed to 80 per cent of the full strength of the plate used. The circumferential seams are to be guaranteed to a strength of 40 per cent that of the plate. All angles are to be made in the field, either lap or butt welded, by making a diagonal cut in a standard pipe section and welding the two parts together after a 180-deg. rotation. No single angles are to be more than 10 deg. This provision is made to secure the desired pipe strength and low friction loss.

The pipe coating is typical of California practice. After the 14-ft. pipe lengths have been immersed in "California asphaltum" at 400 deg. F. for 10 to 15 minutes they are lifted from the bath, drained and then, while still hot, put in a rotating machine and wrapped spirally with "a mica covering" previously impregnated with "a high melting point bituminous compound containing not less than 25 per cent by weight of an alkali-resisting mineral." The impregnated covering must weigh not less than 3.6 lb. per sq.yd. The spiral wrapping, which is 18 in. wide and overlaps about 1 in., is applied under a 50-lb. tension. While the wrapping is being applied a stream of hot asphaltum is poured continuously between it and the pipe. This increases the thickness of the coating, bonds the wrapping to the pipe and seals the joint where the spiral "lay" overlaps. Flake mica is applied to the outside of the pipe covering wherever surplus asphaltum oozes from the wrapping particularly at the joints.

A. Kempkey, consulting engineer, San Francisco, is in charge of design and construction on this extension.

Novelties in the New Water Filters at Windsor, Ontario

UNIQUE features in the new water purification plant at Windsor, Ont., include a double-deck pipe gallery, operation of two filters from one table, attention to architectural effects and a cemented-gravel slab over the perforated-pipe underdrains.

The plant is being built by the Essex Border Utilities Commission, which is a district organization for handling sewage and water utilities for a group of cities on the Canadian side of the river near Detroit. The nominal capacity of the plant is 20 m.g.d., arranged so that the capacity can be doubled when required. The plant is on flat ground and must deliver filtered water by gravity through a rather long pipe line to the pumping stations at Windsor and Walkerville. This condition was met by a shallow clear-water reservoir and an unusually deep coagulating basin of 20-ft. water depth.

The pipe gallery is a two-story affair. The lower portion contains pipes only. The upper part contains valves and rate controllers in a readily accessible position. The floor, which is of concrete, between the upper and lower portions, gives added strength to the filter walls on either side by acting as a brace.

There are ten filters of 2-m.g.d. capacity each, arranged in two rows on either side of the pipe gallery, each of the two facing filters constituting a pair. The filter connections are valved separately and the valves can be operated from the same operating table. The table mechanism is such that the two corresponding valves on each filter can be operated independently by a single lever. The pair of filters has a single rate-controller which can be used for one filter or two filters. The rate-controllers, which are specially made with a range from 1.75 to 4.25 m.g.d., are provided with an integrating recording mechanism. Rising to within about 6 ft. of the top of the filters, the effluent piping then turns horizontally through the controllers and the outlet of

APPLYING BRICK VENEERING TO WALLS OF FILTRATION PLANT AT WINDSOR, ONT.

the controllers dips down and discharges into the clear-water space below the filters. This means that the effluent controllers, during periods when the filter is nearing the end of its run, will operate as a true siphon actuated by the down draft on the pipe leading to the clear-water reservoir.

A neat architectural effect is gained by covering the tops of the filter walls with white glazed brick and providing a wainscoting of white and colored glazed brick around the entire interior of the building. The filter operating floor, as well as the floors of the approach vestibule, are surfaced with terrazzo. The entrance lobby is decorated with marble. All of the exposed concrete walls on the outside of the structures are veneered with 4 in. of brick with an air space.

A 6-in. layer of cemented gravel is laid over the perforated-pipe underdrains at the surface of the gravel layer, which will be about 18 in. in total thickness. The gravel is about the size of navy beans and will be mixed with one part of cement to fourteen or fifteen parts of gravel and placed in the filter. It will thus form a porous layer looking like ordinary gravel but coated with a thin film of cement. It is expected that this cement will hold the gravel together and prevent the material from working up into the sand. If at any time it is desired to penetrate to the bottom of the filter the gravel can easily be broken out and replaced.

J. Clark Keith is chief engineer for the Essex Border Utilities Commission and William Gore, of Toronto, is consulting engineer.

How a Town of 10,000 Revamped Its Water-Works

Financial, Physical and Political Exigencies Overcome—Doubled Rates and Bonds Resulted from Educative Publicity

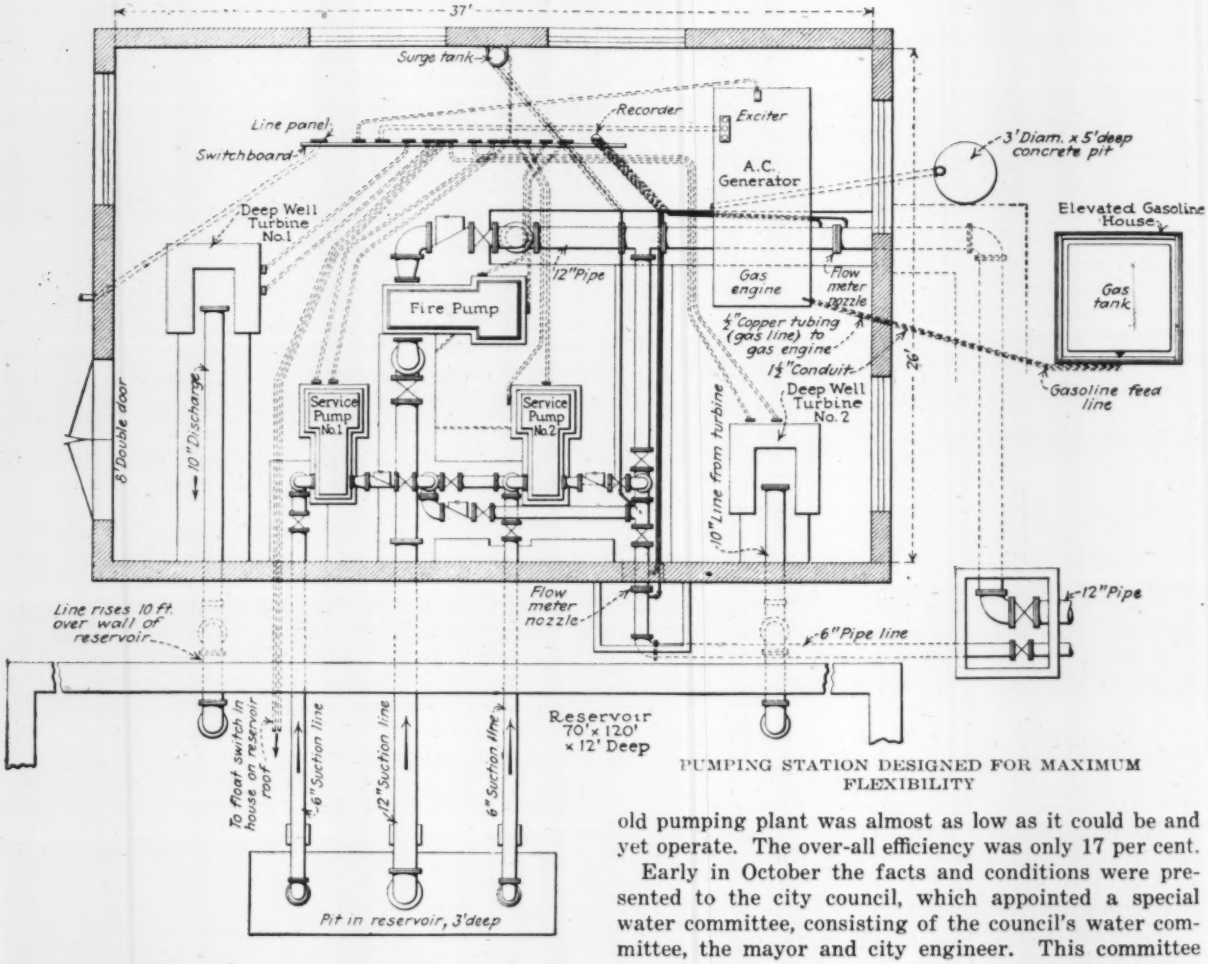
BY H. A. TOLBURG
City Engineer, Monmouth, Ill.

SINCE 1900 the city of Monmouth, Ill., has been confronted with a water-supply situation that has been more serious than the average citizen suspected. Until 1921 the problem was passed along from one administration to another, each trying to shun it. The old pumping equipment had reached such a deplorable state that each year as the warm weather approached the people suffered a water shortage, and the domestic pressure was cut down from 55 lb. to 25 lb. to conserve a small reserve for fire protection. No administration was willing to allow the public to understand the exact condition. In 1921 the city council, realizing that the water-works had been more or less of a political football for years, determined to bring this question to a head by laying the facts before the voters in language that they could understand. It was decided to provide Monmouth with a water system that would be a credit to the city. In July, 1921, the writer was employed as city engineer and given as the paramount problem

Solving the Every-Day

an investigation and subsequent report on the true condition of the water-supply system.

From tests run in September, 1921, to determine the actual pumping cost, it was found that the city was paying 19c. per 1,000 gal. to deliver the water into the mains under 30-lb. pressure. Then the investigation was carried further to determine the condition of the water mains throughout the city. Several of the oldest mains cut into were found to be in as good condition as when new, although they had been in the ground more than thirty years. The physical condition of the old pumping plant was almost as low as it could be and yet operate. The over-all efficiency was only 17 per cent.



PUMPING STATION DESIGNED FOR MAXIMUM FLEXIBILITY

Early in October the facts and conditions were presented to the city council, which appointed a special water committee, consisting of the council's water committee, the mayor and city engineer. This committee formulated several plans of financing the new water system and finally determined on the plan of a $90,000 bond issue.

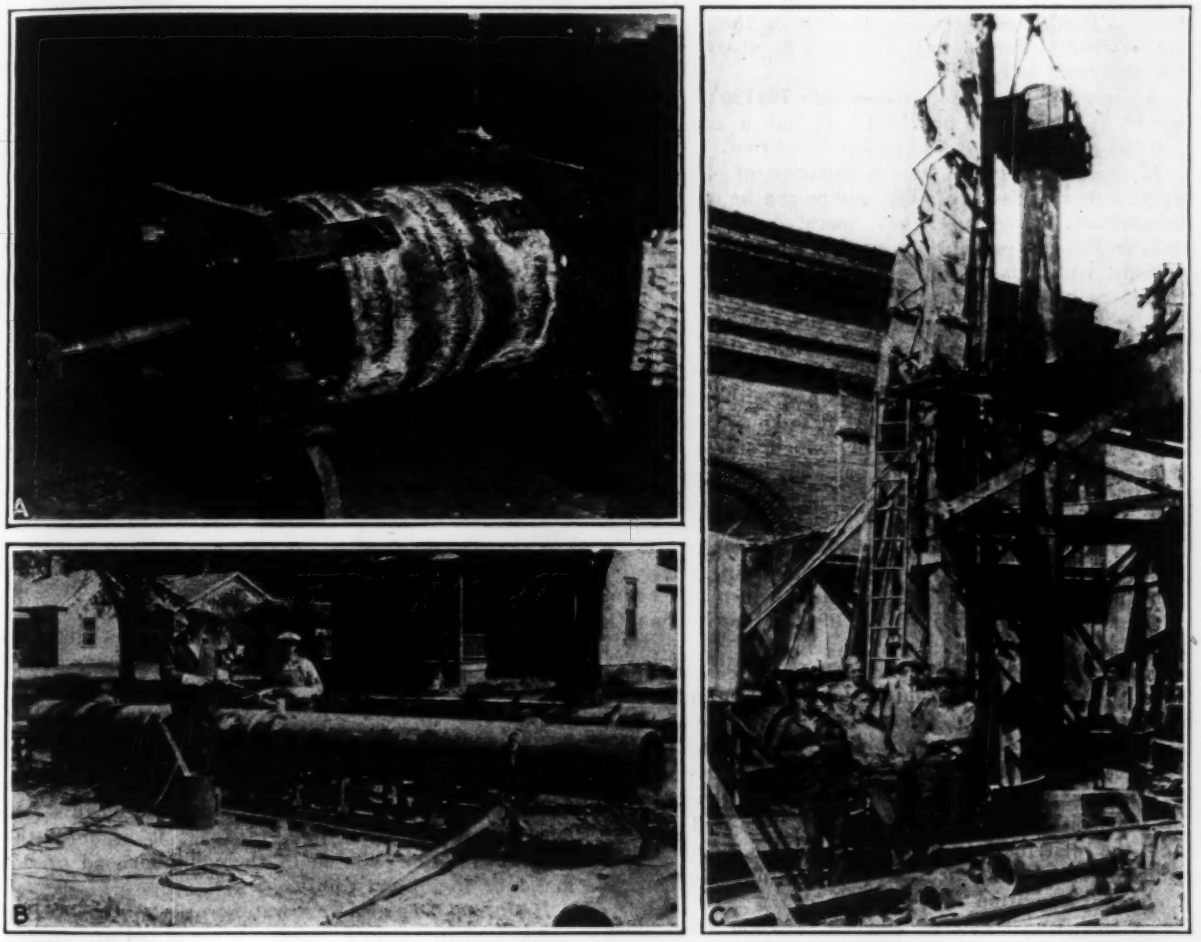
In addition to the bond issue, an ordinance was passed, creating a water-works rebuilding and construction fund, into which $6,000 was to be put each year from the profits of the water-works. To create this profit the water rates were raised from 35c. to 60c. per 1,000 gal. This rate was known to be excessive, but due to almost an emergency it was deemed wise to carry it out. Realizing that it would take a number of years to create a fund sufficiently large enough to rebuild our water-works through this system of rev-

Water-Works Problems

enue, we deemed it wise to have some money to make repairs if necessary, to the present plant while we were building the new plant.

As is often the case in small-town politics, the party which was out was opposed to the water-works plan, only because the "outs" did not want to see the administration reap the glory which was sure to come from the construction of a new plant. Bonds for sufficient funds to carry on the rebuilding program were opposed. It was determined then to enlighten the people as to the needs of a new water plant. Sound business men and good citizens were taken over the old water system and the entire program explained. Later on these citizens were asked to make a statement to the newspapers over their signatures of their findings relative to the needs of a new water-works. This publicity program was laid out covering a period of two months of advertising through the news columns of the press. Each night there appeared some citizen's views of the water-works. On Jan. 8, 1924, at a special election, the bond issue was approved by a vote of two to one.

The plan adopted, now almost completed, consisted of drilling two wells to a depth of 2,445 ft., which penetrated the Potsdam sands. These wells were to be finished at 12½ in. from St. Peter's sands, 1,150 ft. below the surface. Then above that for 662 ft. was used 14-in. outside diameter copperoid pipe, and above that for a distance of 488 ft., was used cast-iron well casing, 18 in. inside diameter. The cast-iron well casing was put together by brazing, which, it is believed, is the first attempt to install cast-iron pipe in a deep well by this method. S. B. Geiger, artesian well contractor of Chicago, had the contract for drilling the two wells, and The Chicago Oxwelding Corporation did the welding. It was found through tests at the Armour Institute of Technology that the brazed joint on 18-in. cast-iron pipe would hold more than 78 tons. As the test was not carried beyond this point, we



WELDING, PLACING AND TESTING WELDED CAST-IRON PIPE FOR MONMOUTH RECONDITIONED WATER-WORKS

A—Rig for testing section of welded pipe for tension. Both joint and pipe withstood 78 tons in tension test which broke a 1½-in. bolt after elongation of ¾ in.

B—Bronze welding two lengths of 18-in. cast-iron pipe in cradle. A band of molten bronze from a ¼-in. brass rod is laid down on the closely butted joint of the two cast-iron pipes. The collar thus built up is about 2 in. wide, ¼ in. thick on the edges and ⅝ in. thick at the center directly over the pipe joint.

C—Two up-ended lengths of pipe after having been welded to pipe already in well. A vertical weld was made by laying the molten bronze against the pipe above a ¼x2-in. collar of flat steel, the upper edge of the collar making a ¼-in. shelf on which to start laying on the welding material. A wood clamp of two 18x18-in. timbers 4 ft. long tightened around the pipe by four 2¼-in. bolts supported finally 56 tons. Drillers' tools may be seen at front of the crew.

could not say how much more the weld would be good for. But that was more than the weight that we had to handle, so the test was not carried to destruction. The insertion of this pipe was successfully carried on without mishap by means of special clamps. The wells are pumped with deep-well turbines, designed for a capacity of 900 g.p.m. against a total head of 214 ft. The static head of the Potsdam waters in Monmouth brings the level to within 183 ft. of the surface. The deep-well turbines are driven by 75-hp. 2,300-volt slip-ring motors, controlled by float switches in the reservoir, so that when the water drops 4 ft. the pumps are automatically started and continued in operation until the reservoir is refilled.

A reservoir of reinforced concrete 70x120 ft. in plan by 12 ft. deep was provided. It has a capacity of 750,000 gal. and is covered with a wood roof.

Each service pump has a capacity of 450 g.p.m. against 60 lb. pressure. The pumps can be operated in parallel or in series. When operated in series they deliver 450 gal. per minute against a total pressure of 120 lb. which is the fire pressure. The units can, therefore, be used at any time to help out the fire pump. The fire pump with a motor of a two-speed type has a capacity of 1,500 g.p.m. and is controlled from the central fire station. When a fire alarm is sounded the chief determines where the fire is and with what pressure he will want to fight it. If it is an ordinary residence fire he presses button 1, which starts his fire pump and gives him 1,000 g.p.m. at 80 lb. pressure. Should the fire be in the factory district or business district he presses button 2 and gets 1,500 g.p.m. at 120-lb. pressure. Then, should he want still more water, it is possible to put the two service pumps in series and get 450 gal. more at 120-lb. pressure, which gives him 1,950 g.p.m., sufficient to combat any fire that Monmouth might have.

The switchboard is of the latest heavy contact type. Each piece of equipment may be operated automatically or manually. For standby equipment, to be used in case the local power plant is out of commission, a 2,300-volt generator of 90-kw. capacity is driven by a 6-cylinder 225-hp. gasoline engine. The generator is of sufficient capacity to operate one deep-well turbine and the distributing pump or the fire pump alone, which makes the service safe for continuous operation under any condition.

To the bond issue of $90,000, $23,000 was added from the water-works rebuilding and construction fund, making $113,000. The total cost of the water plant was $112,860. We expect to retire the bonds within a period of seven years, because the excessive water rate will net a yearly profit and saving by the installation of the new plant of $19,850. This figure will give us a good working margin. Further securing these figures is our contract with the pump company, which guaranteed a surety bond to the amount of the cost of the equipment contract and operating cost of not to exceed 1.92 kw. per 1,000 gal. delivered into the mains under 60-lb. pressure should the pump fail to deliver the water at that rate for one year's time. A favorable contract with the local power company was made whereby we were given electrical power at the rate of 2c. per kw. which will further reduce our operating cost even below the figure the surety bond guaranteed.

The town of 10,000 population too often spends money for local improvements through political channels, rather than through good business channels. It has been our experience in promoting and bringing to a close this water-works issue, that the politicians were the hardest losers, and that unless ways and means are contrived whereby they can use their political stick, then one immediately ceases to be of use to them and at once is criticized by a large number of people. In our case by using good business tactics we were able to educate the average citizen so that he could believe, from knowledge gathered by himself, that the administration was for the people and not the politicians.

Solving the Every-Day

Rehabilitation of Small 30-Year-Old Water-Works Plant

Kirksville, Mo., Plant Brought to Date by New Intake Pumps, Force and Discharge Mains, Filters, Chlorinators and Pipe

By F. M. Veatch
Of Black & Veatch, Consulting Engineers, Kansas City, Mo.

KIRKSVILLE, Missouri, has recently completed and put into operation a modern water purification plant which, together with new supply mains, new pumping equipment and water main extensions, has transformed an obsolete system, constructed piecemeal during the past thirty years, into an up-to-date and efficient water-works.

Kirksville, at the time of the first water-works improvement, 1894, was a town of approximately 2,000 people and has had a rather uniform growth to its present population of 7,500. The city is the birthplace of osteopathy and at the present time the non-resident population due to the two osteopathic colleges together with the Northeastern Missouri Teachers College, amounts to approximately 3,000 persons.

Until now the water consumption has been determined entirely by the amount available, since the supply has been deficient and the new plant has not been in service long enough to establish a rate. It is assumed that the consumption will be in the neighborhood of 0.75 m.g.d. or 75 gal. per capita.

Historical—The original water-works was constructed in 1894, at a cost of $20,000. It consisted of two deep wells, a steam pumping plant, and 23,760 ft. of mains with 40 fire hydrants. This system became inadequate within a few years and an additional $40,000 was spent for improvements, which included a steam pumping plant on the Chariton River, 6½ miles from the city; a 7-in. kalamein force main to the city, and an addition to the distribution system of 20 hydrants and 53,450 ft. of pipe.

In 1900, a 12-m.g. reservoir, in excavation with rip-rapped sides, was constructed at the highest point in the supply line, approximately one mile west of the city, and a small high-service station was added. In 1914, the muddy river water became irksome and two very crude 0.25-m.g.d. uncovered sand filters were constructed together with a 0.5-m.g. coagulating basin and a small open clear-water reservoir. Improvements at the river station included the installation of boilers and the introduction of a 1-m.g.d. crank-and-fly-

Water-Works Problems

wheel steam pump. In 1919, two 600-g.p.m. oil-engine-driven centrifugal pumps were installed, and in 1921 a 100,000-gal. elevated tank was constructed. The makeshift filters were never satisfactory, and in 1922 plans were started for a complete renovation of the system, the movement being furthered by insistent demands of the fire insurance underwriters and by citizens who desired more and better water.

Latest Improvements—The improvements consisted of a new intake line to the river, a 12-in. cast-iron force main to the reservoir to replace the 7-in. kalamein pipe line, which was badly deteriorated and was also inadequate in size, a 1.25-m.g.d. rapid sand filter plant, a new high-service pumping equipment, a new 12-in. discharge line to the city, and considerable extensions to the distribution system. The improvements cost:

Cast-iron pipe	$132,643
Filter plant and clear well	42,178
Pumping equipment	7,583
Valves and hydrants	10,341
Intake and suction pit	5,158
Pipe line construction	38,650
Chlorinator	1,325
Filter equipment	7,621
Total	$245,199

Intake—The new intake consists of a substantial concrete crib extending to rock, fitted with a removable bar screen, and connected to a concrete suction well, on the river bank by means of a 20-in. cast-iron pipe.

Low-Service Pumping Plant—The existing river plant was not changed, as the pump is in good working condition and a city owned and operated coal mine, a few feet from the boiler room door from which coal is delivered to the boilers at a cost of approximately $2 per ton, makes this method of pumping most economical.

Force Main—The force main from the river to the reservoir and the discharge main from the filter plant to the city, were constructed of standard cast-iron pipe, with the Classes A, B, and C distributed according to the pressure, and contain approximately 1,480 tons of pipe which cost f.o.b. Kirksville, $64.17 per ton for Class A and $59.17 per ton for Classes B and C. The contract price for laying the line, inclusive of hauling, trenching, backfilling and all labor and line materials, was $0.43 per foot.

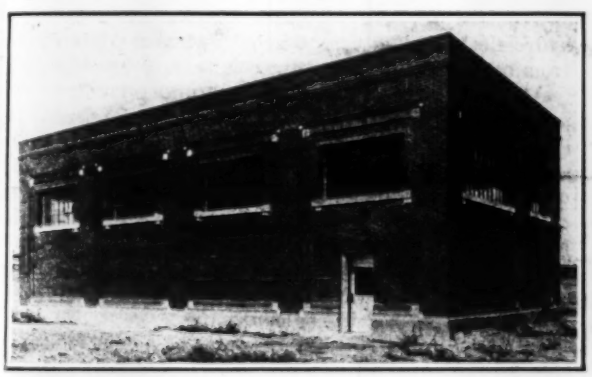
Purification Plant—The existing 12-m.g. reservoir was left without change, since the leakage is negligible, and the existing coagulating basin was utilized by the construction of weirs and baffles to provide for 1-hr. mixing and to eliminate short-circuiting. Alum alone is used for coagulation since the large storage capacity precludes excessive turbidity and this chemical is fed by means of solution tanks and orifice boxes, at the inlet and at the outlet of the coagulation basin. The filter plant is of standard construction throughout and consists of three 0.5-m.g.d., hydraulically operated units, completely housed in a fireproof brick-and-concrete building, which also houses the high-service pumps.

The available location of the filter plant made it necessary to have the operating floor approximately 10 ft. above the normal ground level. To prevent excessive and unsightly filling, around the filter cells, the walls of the building were brought up outside the concrete work, with a 3-in. air space left between the inner and outer walls to prevent freezing and spalling of the damp walls of the filter cells. This construction permitted the pipe gallery and pump room to be at the ground level, desirable for light and convenience.

Liquid chlorine is used for sterilization and is fed into the suction header through a Wallace & Tiernan pedestal-type machine.

A 0.66-m.g. rectangular covered clear-water well of reinforced concrete was provided, located adjacent to the pump room.

The total cost of the purification plant was $42,178 and the unit prices per cubic yard were as follows: excavation, $1; reinforced concrete, $25; plain concrete, $20.



EXTERIOR AND INTERIOR VIEWS OF NEW MECHANICAL FILTER PLANT FOR WATER-WORKS OF KIRKSVILLE, MO.

Pumping equipment—Electrical power was selected for use at the high-service station since the available prices for current were favorable and since, eventually, the city will install generators at the river station where cheap coal is available. Two motor-driven 600-g.p.m. centrifugal pumps were installed for ordinary use, and a 1,000-g.p.m. steam-engine-driven centrifugal pump was installed for emergency use and for fire protection. Wash-water for the filters is pumped by means of a gasoline-engine-driven 2,700-g.p.m. centrifugal pump. The cost of the pumping equipment was $7,583.40.

Extensions to Mains—The extensions to the distribution system included the removal of 16,470 lin.ft. of 4-in. steel pipe and the installation of 30 hydrants, 2,970 ft. of 4-in., 17,360 ft. of 6-in., 10,520 ft. of 8-in., and 3,280 ft. of 12-in. cast-iron pipe. Class B standard cast pipe was used throughout and cost $63.17 per ton for 4-in. and $59.17 per ton for 6-in. and larger. The costs of pipe laying, in cents per foot, were: 4-in., 27; 6-in., 33; 8-in., 36; 12-in., 48.

The engineers for the work were Black & Veatch, Kansas City, Missouri.

Water District and Power Company Adjust Differences

By Arthur L. Shaw
Designing Engineer, Metcalf & Eddy, Boston, Mass.

THE COMPLETION of the new electric pumping plant of the Kennebec Water District at Waterville, Me., late in the summer of 1924, marked the consummation of a project whereby a publicly-owned and a privately-owned utility with conflicting interests were able to adjust their differences to mutual advantage. Prior to 1919, the water district pumped the water required by Waterville, Fairfield, Winslow and Benton mainly by means of water power owned by the district on Messalonskee Stream. A steam plant was held in reserve and used only when the water power was inadequate. The Central Maine Power Co. operated several hydro-electric stations at various points along the same stream, the newest of which was the Rice's Rip development, about four miles upstream from the district's pumping station.

When the Rice's Rip plant was put into operation, in 1919, the method of operation of this chain of development in conjunction with the rest of the Central Maine system was such that water was withheld except for 9 or 10 hours each day, during which time the rate of flow was so great that it could not be utilized to advantage by the Kennebec Water District. The limitations of the water-supply aqueduct, from China Lake, 8.4 miles distant, and of the distribution system, made impossible the pumping of the entire daily supply in so short a period. In consequence, the Kennebec Water District was forced to pump largely by steam and later by electrically-driven pumps installed to supplement the steam plant in this emergency.

Litigation followed, but was discontinued in 1923

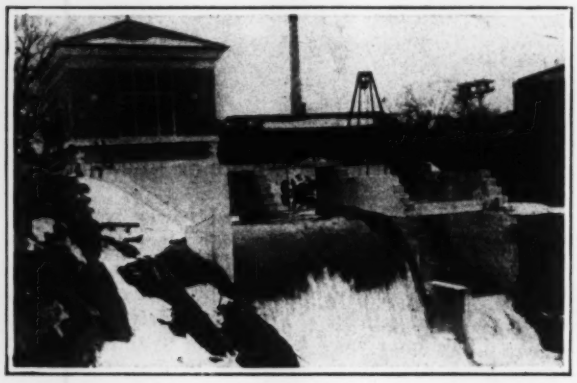


FIG. 1—NEW DAM AND HYDRO-ELECTRIC STATION, WATERVILLE, ME.

This hydro-electric plant of the Central Maine Power Co., Waterville, supplies current to drive pumps of the Kennebec Water District.

when an out-of-court agreement was reached under the terms of which the Central Maine Power Co. is given a long lease of the Kennebec Water District privileges and the district in return is to receive power from the Central Maine system without charge up to amounts estimated to be equivalent to the water power which the district might have developed for pumping had there been no interference from the company's development. Under the agreement the company has built a new dam and 1,000-kva. power house (Fig. 1), combining the heads of the two old dams affected by the agreement, and the water district has constructed a new electrically-driven pumping station (see sub-title of Fig. 2 for equipment, including laboratory).

Solving the Every-Day

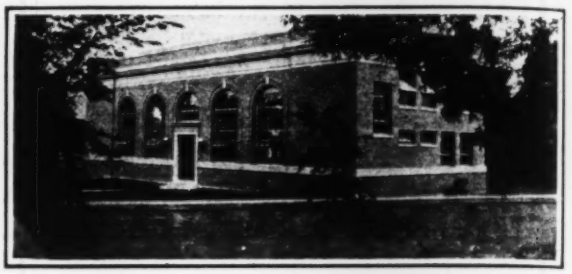


FIG. 2—NEW ELECTRIC PUMPING STATION OF KENNEBEC WATER DISTRICT, WATERVILLE, ME.

Contains three motor-driven centrifugal pumping units of 2-, 2.5- and 3-m.g.d. nominal capacity, with space for a fourth unit; traveling crane, gages, Venturi meter register, chlorinating apparatus and heating plant; also a water laboratory in an upper room.

The hydro-electric power plant is operated by push-button from the pumping station and the current is delivered onto a switchboard in the pumping station whence it is taken for driving the motors or dispatched to the outside lines of the power company. If power is required for the pumping station, when the new hydro-electric plant is not being operated, it is drawn from other lines of the power company.

As the result of the existing understanding, the power company is enabled to develop and operate its several plants along the Messalonskee Stream in the most economical and advantageous manner, without encroachment on the rights of others, and the water district is provided with free power for its present and probable future pumping needs for a considerable time to come, thus affecting a mutually beneficial solution of a problem which promised vexatious and protracted controversy in the courts.

Copper Sulphate Sown on Ice of Cheyenne Water-Works Reservoirs

By P. R. Revis
City Engineer, Cheyenne, Wyo.

IN applying copper sulphate to the two reservoirs of the Cheyenne water-works this year, the chemical was scattered on the ice or sowed like grain instead of being distributed as heretofore by means of bags drawn through the water by boats. The old method was a slow, expensive and uncertain process, the chemical not being evenly distributed over the large area of our reservoirs. Strong winds endangered the lives of the boatmen and the distribution was so poor that the water sometimes had a disagreeable taste for a few weeks on account of not all the algæ growth being prevented. Application by boats was performed twice a year, once in April and again in August.

The work this year, on the ice, was done in mid-winter. Taking advantage of a wind, each man covered a strip 150 ft. wide at a single passage across the ice.

The size and capacity of the reservoirs are as follows: Granite Springs, 185 acres in area with a capacity of 1,734 m.g.; Crystal Lake, 127 acres and 1,482 m.g. capacity. A total of 9,625 lb. of copper sulphate

Water-Works Problems

was used, which was the equivalent of very slightly over 30 lb. for each acre covered and at a dosing rate of 3 lb. per m.g. Four men did the work in five days.

The sulphate is in solution before it goes through the ice and is therefore not strong enough to be injurious to fish life, yet is sufficiently strong to have the desired effect upon algæ growth. Some two weeks after the copper sulphate was scattered or at about the close of February, the ice was broken up. It is expected that it will not be necessary to treat these reservoirs again this year.

So far as the writer is aware, this method of treatment was never used before.

Drain Valve for Chemical Solution Tanks at Filter Plants

By C. L. B. Anderson
Portsmouth, Va.

THE following description of a drain valve for chemical solution tanks, developed along lines radically different from valves commonly used in rapid sand filter plants for this particular service, is offered as a remedy for the troubles experienced with such valves, especially in the smaller plants. In valves of designs commonly used, the corrosion of all the working parts and of the seats by the chemical solutions, and the damage to the seats, disks and gates caused by sediment and grit in the valves when they are being closed, are the principal causes of the deterioration. During the fifteen years' experience of the writer in the design of rapid sand filter plants, different types of valves such as wedge gate and double-disk gate valves, angle valves and cross-valves, and valves with working parts of different materials—as iron, bronze, brass and monel metal—were experimented with.

For use in soda solution tanks, and, to a lesser degree, in lime solution tanks, iron mounted angle valves have given the best service of any of the standard types used. In the larger sizes, wedge gate, sliding stem, quick opening gate valves, iron trimmed, have also given very good service. Plug corks are unsatisfactory.

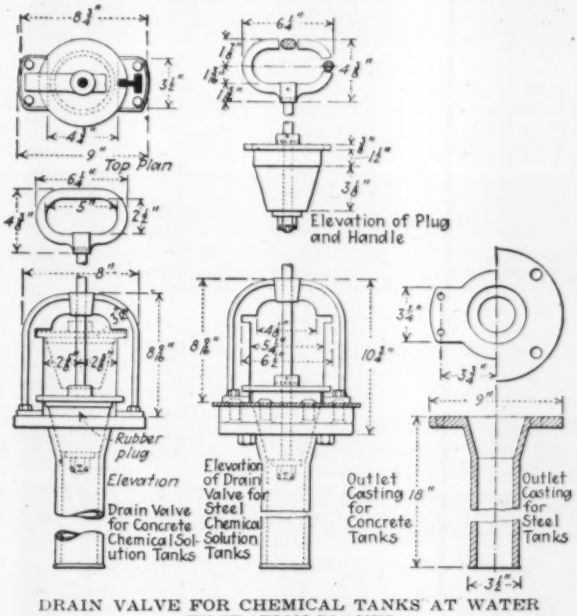
In tanks used for sulphate of alumina and hypochlorite solutions standard commercial type valves have not proved satisfactory, but the best service has been obtained with valves having seats and working parts of bronze or monel metal. Phosphor bronze seemed to give the best service while Tobin bronze and monel metal gave approximately 80 per cent the service obtained from phosphor bronze.

The unsatisfactory service obtained from even the best constructed and special trimmed standard commercial type valves has caused many operators in the smaller plants to use light-weight standard angle or gate valves, with the expectation of renewing them from time to time as occasion demanded. This plan has the objection, in addition to the expense and trouble of renewals, of loss of chemical solution through valve leakage. In the smaller plants, where the chemical dosage is often based on the fall of the solution level in the chemical storage tanks, the uncertainty due to leakage is a factor to be considered.

A satisfactory drain valve for chemical tanks must embody these characteristics: (1) simplicity of design; (2) few moving parts; (3) resistance to corrosion; (4) adaptability to different kinds of solutions; (5) not damaged by grit and sediment; (6) watertight under all conditions of service; (7) accessible for inspection; (8) easily repaired.

During a visit about fifteen years ago to a small plant in New Jersey, the name of which cannot be recalled, the writer saw an effective, although crude, method that had been used to solve operating difficulties. This gave the writer an idea for the design of a valve which has seemed, after several years service, to answer satisfactorily the above requirements. The plant operator had just constructed concrete solution tanks the bottoms of which sloped to one corner. He had molded a funnel-shaped opening in the concrete leading to a drain pipe. These openings were closed with tapered wooden plugs surfaced with rubber gasket material, the plugs having wooden handles.

From the arrangement just described the writer developed the valve shown in the accompanying drawing. The following quotation from specifications under which the valves were furnished will more fully describe them:


Top Plan
Elevation of Plug and Handle
Rubber plug
Elevation
Drain Valve for Concrete Chemical Solution Tanks
Elevation of Drain Valve for Steel Chemical Solution Tanks
Outlet Casting for Concrete Tanks
Outlet Casting for Steel Tanks

DRAIN VALVE FOR CHEMICAL TANKS AT WATER FILTRATION PLANTS

Drain Valves For Chemical Solution Tanks—This valve is to consist of a body casting of cast iron to which is to be bolted with tap bolts a yoke forming a guide and support for the operating mechanism. The opening in the body casting is to be closed with a soft rubber plug connected with a rod and handle for operating the valve. For the steel lime and soda tank this valve is to be specially constructed as shown in the drawing. In this case all parts of the valve, with the exception of the rubber plug, shall be constructed of cast iron, steel and wrought iron as far as the same may be used. In the drain valve for the other solution tanks the rod to which the rubber plug is attached, together with castle nut, washers, cotter keys and tap bolts, are to be made from Tobin bronze. The drain valve is designed to be used in connection with standard 3-in. soil pipe. Steady bearings for the valve stems are to be furnished and placed near the tops of the solution tanks.

By the use of a thick washer above the rubber plug the same design and parts used with the concrete tanks are made adaptable for use with steel tanks, being fastened to a pad riveted to the bottom of the tanks.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Should Floor Slabs in Shallow Truss Spans Be Made Discontinuous?

Sir—Recently an 80-ft. half-through truss span was given me for checking the design. The span was designed for 20-ft. roadway between curbs. The trusses had a depth of 9 ft. c. to c. of chords with eight 10-ft. panels. The top chord was made up of two 10-in. channels 25 lb. per ft., and one 14x⅞-in. cover plate at the center of the span. The bottom chord was composed of two 10-in. channels 35 lb. per ft.

The concrete floor slab was designed continuous over floorbeams at panel points. The live-load was given as two 15-ton trucks with 6 tons on each rear wheel. The spacing of axles was 12 ft. c. to c., and 9 ft. c. to c. of trucks. It was possible for two trucks either to pass or meet, allowing four wheels in a transverse line. The slab was designed with the formula $\frac{1}{10}\ wl^2$ for dead-load and $0.8 \times \frac{1}{4}Pl$ for concentrated load with 30 per cent added for impact, and was 9½ in. in total depth. It was reinforced with ⅝-in. round rods spaced 4½ in. horizontally 1½ in. from top and bottom over supports and center of panels, and similar rods spaced 9 in. horizontally at bottom and top at the same points.

No attention was given to the evident deflection that would occur in the trusses, which would completely destroy the assumption of rigid supports on which the formulas used in the design were based. The slab as designed gave 650 lb. per sq.in. on the concrete and 16,000 lb. per sq.in. on the steel, assuming the formulas to give correct results. However, taking account of slopes and deflections due to the deflection of the trusses, by a graphical method, the stresses were 850 and 21,000.

These results indicate that the slab would be more effective if cut at the floorbeams, as the stresses would then be only 800 and 20,000.

If it is desired to design for stresses of 650 and 16,000, the continuous slab would require a greater depth than is required by simple slabs in each panel. In this case the continuous slab would call for a depth 10.7 in. and the simple slab for 10.4 in.

J. L. ALBERS,
Structural Engineer, Tennessee Department of Highways and Public Works.

Nashville, Tenn.
Feb. 27, 1925.

Asphyxiation Due to Oxygen Depletion

Sir—The letter in *Engineering News-Record*, April 2, p. 572, on "Asphyxiation Due to Oxygen Depletion," by F. H. Holway of Tulsa, Okla., is very interesting and instructive. I believe that the correct explanation has been given of the death of the engineer who went into the bottom of this concrete chamber.

Carbon dioxide is heavier than air, its specific gravity being 1.529. Consequently, with the chamber covered over and no agitation of the air within the chamber, the carbon dioxide would settle in a dense layer at the bottom. The first man into this carbon dioxide would, of course, suffer the most concentrated effect of it. Also when the lid was taken off the chamber, the outside air, which was probably cooler than that in the chamber, would settle and produce a certain amount of ventilation if the heavily charged carbon dioxide air in the bottom of the chamber were agitated.

The question as to whether or not the concrete might have contributed any part of the CO_2 is best answered by the fact that a fresh concrete surface absorbs CO_2 instead of giving it off. In the process of hardening, calcium hydroxide occurs on the exposed surface of concrete which in contact with air, which always contains CO_2 and which in this case contains a great deal of this gas, takes up the CO_2 and forms calcium carbonate. Of course, the amount of CO_2 thus absorbed is a very small amount and produces only a skin coating on the surface of the concrete. The amount thus absorbed would, therefore, have no appreciable effect in reducing the foul condition of the air at the bottom of the chamber.

There is another possibility, of course, that might have contributed to this tragedy. Carbon dioxide is formed in the earth whenever an acid solution comes in contact with the carbonate, and CO_2 is frequently given off from fissures in the earth. If, after pulling the forms, some honeycomb places in the concrete were uncovered, and if carbon dioxide was being given off from earth fissures close to these honeycomb places, there is a possibility, of course, that the carbon dioxide in the bottom of the well might have been augmented from this source.

A. C. IRWIN,
Manager, Railways Bureau, Portland Cement Association.

Chicago, Ill.
March 26, 1925.

Highway Bridge Impact Moderate

Sir—The editorial entitled "Dangerous Impact Action" in your March 19 issue, p. 464, has a special interest to me, as it was my privilege to be connected with the tests referred to while a graduate student at Iowa State College of Agriculture and Mechanic Arts during the summer of 1923. I do not believe the impression, given by the editorial, that highway bridges must be designed for extremely high impact stresses, is warranted by any published data of the Iowa tests.

The determination of impact on highway bridges is an extremely difficult task and is accompanied by many variable effects which render individual readings, or even sets of readings, open to suspicion. This will be true till we are able to design better instruments than we now have for this type of work. It therefore does not seem that the conclusion "impact is measured more properly by the extreme or highest values obtained in a series of experiments rather than by the average values" may properly be drawn from the data.

Again quoting from the editorial, "Because of the variability of the effect, there is the further possibility that under full loading (with a number of trucks on a bridge at the same time) larger impact percentages may result than in the case of only one or two trucks. The effects due to the individual trucks may neutralize each other or they may reinforce each other, and in the extreme case they may produce a larger total stress than corresponds to the sum of their individual effects." This is inconceivable to me. The large impact percentages given in the report of Professor Fuller are due to a 2x4 placed in the most unfavorable position for the member being considered. Even if it is admitted as a possibility that a fleet of trucks traveling at ten miles an hour, close together, would all hit potholes in the bridge floor equivalent to 2x4's, so timed as to produce simultaneous effects in any given member, still the trucks distant from this member would produce effects much less in percentage than those produced by the truck passing over the unfavorable pothole, for the inertia and elasticity of the structure itself would absorb part of the effect. Note that the percentage of impact in the end post is approximately only one-quarter to one-half as great as in the hip-vertical, although for impact in these two members the 2x4 is placed in the same position. In any case the above quoted conclusion could not be drawn from the data presented thus far by Professor Fuller, neither could one say that the impact due to a fleet of trucks is necessarily as large as for one truck.

In the Iowa Bridge Specifications the paragraphs relating to impact, based on the 1922 tests, call for 33⅓ per cent impact for the floor system, 66⅔ per cent for floorbeam hangers, and for the truss members as given by the formula

$$I = \frac{75}{L + 200} S$$

where L equals the loaded length in feet producing the maximum stress in the member and S equals the computed maximum live-load stress. This portion of the specification was written by Professor Fuller, I believe. Certainly nothing extreme here.

Professor Fuller and his co-workers are doing a very able piece of work on this difficult task. I dislike to see conclusions drawn from these tests which are unwarranted and may prove very expensive if put into practice.

E. A. MACLEAN.

Urbana, Ill.
April 3, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Singstad Promoted to Chief Engineer of Commission

Work of Holland and Freeman to be Carried on by Engineer Who Served Under Them

Ole Singstad, engineer of design of the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission on the construction of the Holland tunnel, has been appointed chief engineer to succeed the late Milton H. Freeman.

Mr. Singstad was born in Norway June 29, 1882, and graduated from the Polytechnic Institute of Trondhjem, with the degree of civil engineer in 1905. The same year Mr. Singstad came to New York, and after serving for a few months with the Central Railroad of New Jersey as a transitman went to the engineering department of the Virginian Railway Co., where he served for two years as assistant engineer in charge of construction on the New River Bridge and the Hampton Roads terminal. From March, 1909, to March, 1910, he worked for the Hudson-Manhattan Railroad Co., New York, on the design of the Hudson River tunnel, and from March, 1910, to September, 1917, with the Public Service Commission, First District, in charge of design of subways and tunnels in New York and Brooklyn, including the Williams St.-East River-Clark St. tunnel. From September, 1917, to June, 1919, Mr. Singstad was first with the Chili Exploration Co., of New York, in charge of structural design and then with Barclay Parsons & Klapp, consulting engineers, New York, in charge of laying out and estimating a rapid transit system and preparing preliminary designs and estimates on a vehicular tunnel.

In July, 1919, Mr. Singstad joined the New York and New Jersey Bridge & Tunnel Commission, first as designing engineer, July, 1919, to July, 1921, and then as engineer of designs until his appointment to be chief engineer.

Money Voted for New Jersey Ship Canal Project

The project to construct a ship canal across the State of New Jersey from Trenton to Raritan Bay as part of the intracoastal canal system has been advanced by the appropriation of $150,000 by the state legislature for the purchase of right-of-way, and by the inclusion in the rivers and harbors bill of an item of $1,350,000 for the dredging of a 20-ft. channel in the Delaware River from Philadelphia to Trenton. The New Jersey Legislature expects to have part of the proceeds of the sale of the Morris & Essex canal to devote to the purpose of buying right-of-way for the new ship canal in addition to the amount appropriated.

Engineering Fifty Years Ago

From *Engineering News*, April, 1875

Abstract of an 1855 Report by E. S. Chesborough, City Engineer of Chicago, Ill.

WHAT Shall the Sewerage of the City Be Drained Into? Four principal plans, besides modifications, have been proposed:

(1). Into the river and branches directly, and thence into the Lake.

(2). Directly into the lake.

(3). Into artificial reservoirs, to be thence pumped up and used as manure.

(4). Into the river, and thence by the proposed steamboat canal into the Illinois River.

With regard to the fourth plan, or draining into the proposed steamboat canal, which would divert a large and constantly flowing stream, from Lake Michigan into the Illinois River, it is too remote a contingency to be relied upon for present purposes; besides, the cost of it, or any other similar channel in that direction, sufficient to drain off the sewage of the city, would be not only far more than the present sewerage law provides for, but more than would be necessary to construct sewers for five times the present population.

Should the proposed steamboat canal ever be made for commercial purposes, the plan now recommended would be about as well adapted to such a state of things as it is to the present, making it necessary to abandon only the proposed method of supplying the South Branch with fresh water from the Lake, and to pump up from the new canal, or draw from the DesPlaines directly, flushing water for the West District, instead of obtaining it from the present canal at Bridgeport as herein recommended.

Progress on Exchequer Dam in California

Exchequer Dam, which is being built by the Merced Irrigation District on the Merced River in California, has now been under construction for six months. In that time, in addition to getting a very complete plant and equipment installed within the limited space in the canyon where the dam is located, some 72,000 cu. yd. of concrete have been poured, and the dam has been brought to a height of 110 ft. above foundation. The ultimate height of the structure will be 325 ft. and the completion date is set for early next year.

Thus far the plant at the dam has been developed to the point where it can pour about 2,000 cu. yd. of concrete per day. The contract is being carried out by Bent Bros. of Los Angeles.

City and Regional Planning Conference to Be Held

Three Organizations to Meet in New York City in April—Exhibit at Grand Central Palace

Regional planning, arterial roads, water fronts and waterways, and zoning practice in America will be the leading topics before the International Town, City and Regional Planning Conference to be held in New York City, April 20-25. Joining in the conference will be the American City Planning Institute, the National Conference on City Planning, and the International Federation for Town and Country Planning and Garden Cities, together with various affiliated organizations. An exhibit of city planning material from all over the world will be held at the Hotel Pennsylvania and at Grand Central Palace.

Among the many American and foreign speakers at the congress, the following may be noted: Dr. R. Heiligenthal, Oberbaurat, Berlin, and Dr. Raymond Unwin, chief housing architect to the British Ministry of Health, who will speak on methods of distribution of people and industries within a region; G. L. Pepler, chief town planning inspector, British Ministry of Health, and Dr. Joseph Brix, regierungsrat, professor at the Technical High School, Berlin-Charlottenburg, who will discuss arterial roads; Thomas Adams, general director, Regional Plan of New York and Its Environs, who will outline the plan just mentioned, and Col. William J. Wilgus, consulting engineer, New York City, who will take up transportation around New York.

A review of the progress in planning throughout the world will be given by George B. Ford, president, National Conference on City Planning, and D. Everett Waid, president, American Institute of Architects. Speakers under the heading, "Water Fronts and Waterways," will be Col. P. L. Gerhardt, vice-president, Bush Terminal Co., Brooklyn, N. Y., who will take up commercial development, and Jay Downer, consulting engineer and executive, Westchester County Park Commission, New York, who will consider recreational development. City planning as a permanent solution of the traffic problem will be presented by Morris Knowles, consulting engineer, Pittsburgh. Platting or site planning will be presented by Prof. Sverre Pederson, city architect, Trondhjem, Norway, and zoning of undeveloped areas, by Robert Whitten, city planner, Cleveland, and protecting the official street plan, by Philip Nichols.

The speakers on zoning practice in America will be Edward M. Bassett, New York City, Lawrence V. Sheridan, Indianapolis, and T. Glenn Phillips, Detroit, and E. P. Goodrich and Harvey W. Corbett, New York City.

Labor and Capital Discuss Industrial Co-operation

Hoover, Swope and Green Speak at Round Table at Civic Federation Meeting at New York

Waste elimination and the minimizing of industrial controversy were discussed from the sides of employer, employee and the public at the first Industrial Round Table of the National Civic Federation, in New York, April 11. Herbert Hoover, Sercetary of Commerce, and Gerard Swope, president of the General Electric Co., in striking phrase, gave the viewpoints of the public and of the employer respectively while William Green, president of the American Federation of Labor, made a comprehensive and dramatic pronouncement regarding the attitude of labor toward industrial controversy and waste elimination.

Mr. Hoover's text was that the greatest opportunity for increased wages and higher standards of living for the worker lay in eliminating industrial wastes. These wastes can be reduced only by collective effort. "They contain," he declared, "the paradox that if we save collectively, we will have more goods and services to expend individually." Illustrating the possibilities, he commented on the fine showing of our railways in the last three years. They have handled a 14 per cent increase in gross operating expenses. Rates have been decreased over 5 per cent, the hours of the workers have decreased and the wage has increased slightly. Service to the community has been immeasurably improved, and this is due to great effort in management, and the co-operation of the employees and of the community itself. He cited also the waste elimination efforts under way in the construction industry as typical of effective collective effort.

He declared that there is hope that America is finding a solution of the problem of securing social satisfaction with the preservation of private industry, of initiative and full development of the individual. This is being brought about by recognition of the identity of interest of employer and employed and the effort to organize that identity in order to limit the area of conflict. Waste elimination is one of the subjects in which there is identity of interest.

Making the Employee Think

Mr. Swope maintained that waste elimination can be greatly furthered if the thought of the workers can be directed to the subject. He related that in an organization of 60,000 workers, 8,000 suggestions were received in 1923 and 10,000 in 1924. Of these 5,000 had been put in practice, and $100,000 had been paid, over and above wages, to the workers who had made the suggestions. He stood, he declared, for lower selling prices of commodities and showed that lower prices are not incompatible with higher wages. Incandescent lamps, for example, are now cheaper than they were before the war, yet the earnings of the workers have increased 100 per cent. The "labor content" of each lamp, however, has been decreased. This has been brought about by more efficient methods.

He further discussed the larger value of workers' suggestions and of the relations between management and employee, and closed his remarks as follows:

"Probably the most tragic waste of all in industry is unemployment, where men ready and willing and able to work, are unable to secure it, and where society really needs their work. The most severe test of any social system is the consideration it gives to the human being, and our present system must find a solution of this great human problem.

"Industry also is much more cordial today than ever before toward the problem involved in minimizing industrial controversy. It is recognized that if you have the sympathy and understanding of the workmen, the *esprit de corps* of an organization will be much better, work will go more smoothly, the material results accomplished will be greater, and the human satisfaction to all concerned will be vastly increased.

"As business is organized today, most companies have a large number of shareholders to whom they report periodically as to the results of operations, and there is every reason why the working-men should be kept informed of the development of the business so that they also can see whitherward it is tending. This has been accomplished in many instances with marked success by having the representatives of the men meet with the management for the purpose of discussing various problems as they arise, so that the men will have a general understanding as to the business of the company. One of the gratifying results has been the increased satisfaction on the part of the working-men, and the largely decreased turnover of labor, partly because of this.

"There is still much to be done and the most hopeful aspect of the problem is that management and men are approaching it more openmindedly."

Attitude of Labor

Mr. Green declared at the outset that labor believes that production costs should be lowered through the promotion of efficiency in workmanship and management, the elimination of waste and the introduction of economy processes. Unreasonable competition is one of the primary causes of waste, leading even to a disregard of human life and human welfare. He cited a great basic industry (admitting after his address that it was the bituminous coal mining industry) in which, as the result of competition, there is at present shocking disorganization and human suffering. Since labor organizations cannot be destroyed why not, he pleaded, "recognize their value and merit and accept from them the benefits they can give through their organized effort?"

The workers realize that their welfare in a great measure depends upon the maintenance of peace in industry. They have believed that it could better be maintained through collective bargaining. He insisted that efforts of employers to prevent the organization of workers is a waste of time, money and effort, that should be eliminated. Labor, he declared, dramatically, is not un-American. It is sound, constructive, practical and rational. It has been forced to take a militant attitude in order to maintain its very existence. It does not want to waste its energies in industrial conflicts. It understands fully the costs of industrial strife, but it is determined to assert its right to organize and bargain collectively, regardless of cost or sacrifice.

"I am confident that we can minimize industrial controversy through a proper regard and recognition of the rights of both employers and employees. The right of the employer to manage his industry, to control it and to receive a fair profit upon his investment should be maintained and recognized. The right of the employees to organize, to bargain collectively, to be represented in conference with employers, through their chosen representatives, is a right which should be readily accorded and completely recognized. A religious observance of these rights will do more to minimize industrial controversy than the application of any rule or formula.

"Supplementing the recognition of these simple rights must come understanding, co-operation and the manifestation of a mutuality of interest in the management and conduct of industry. Good faith and good will must be firmly established. Perfect candor must characterize the attitude and relationship of both employers and employees."

No Failure of Flat Rock Dam

Press reports that the new dam of the Ford Motor Company on the Huron River at Flat Rock, Mich., recently completed by Stone & Webster, had failed on April 14 are unfounded. The real trouble on Huron River was at the dam of the Detroit Edison Co. at French Landing a few miles above Flat Rock where part of the embankment was washed out by the high water. The damage to the dam is estimated at $20,000. No damage was done to the new dam at Flat Rock.

San Francisco to Build Duboce Tunnel on Assessment Plan

On April 6 the San Francisco Board of Supervisors voted to build the Duboce Tunnel at an estimated cost of $1,654,000 with funds to be raised by levy upon an assessment district. This tunnel, generally speaking, will parallel the Twin Peaks bore a few squares north, extending under a summit known as "Mt. Olympus." It will have a length of 4,232 ft. with an eastern portal at Duboce Park and a western portal at Cole and Frederick Streets. The tunnel is to be made 25 ft. wide to accommodate a double track electric railway and will be concrete lined throughout. No vehicular traffic is to be provided for. The construction period is estimated at 15 months and work is to start next August. The excavation involved totals 121,722 cu.yd. with 23,086 cu.yd. of concrete and 600 tons of reinforcing steel.

WASHINGTON NOTES

To comply with the provisions of the new River and Harbor Act the Corps of Engineers and the Federal Trade Commission are gathering data as to the cost of a comprehensive survey of the rivers of the country in order to establish the fact that such a survey is urgently needed in order that power development, navigation improvements, and flood control can be carried forward in the most effective fashion. There was reason to believe that the act, which now provides for a report setting forth the need for and expenses of such a survey, would have provided for the survey itself, but differences of opinion among those interested in obtaining the legislation prevented that action.

General Harry Taylor, Chief of Engineers, states that his first step in carrying out the mandate of Congress will be to call for a report from each of his district offices which will cover the needs of that particular section. This preliminary report will set forth the data obtainable in the files of each office. When these reports have been examined such additional information as may be needed then will be called for.

The Federal Power Commission will confine its work to the need of a nation-wide survey of rivers and streams. Because of the lack of a definite program for the development of power and navigation on each stream the Federal Power Commission is compelled to grant licenses without knowing whether the proposed project will fit into a plan for the maximum utilization of the stream's resources or will aid in flood control and navigation. It is not the object of the proposed survey to go into great detail concerning each stream, but rather to get an accurate picture of the whole river and let the details be worked out when development is undertaken. Congress has already declared its intention to use license fees and rental receipts for such surveys, but so far has not passed the enabling act to make the money from this source, which amounts to about $250,000 annually, available for this work.

The report is now being prepared with the idea of having it ready in case an extra session is called. It is expected to be so convincing that little further delay will result in securing the necessary legislation.

The appeal of the county of Tuolumne, city of Sonora and others from a decision of the Supreme Court of California sustaining an order of the California Railroad Commission increasing water charges for the Tuolumne ditch because of excluding earnings from hydro-electric developments on the ditch, was dismissed for want of jurisdiction by the U. S. Supreme Court March 16 without a written opinion.

The case involved the construction of the contracts made with water-users by the Tuolumne County Water Co. in 1850, when the ditch was constructed, by which it was contended that the charges against users of water for irrigation purposes and for consumption were to be reduced by any earnings from power or other uses of the water. Originally, there were earnings from mine use of water and from use as direct power over waterwheels. Eventually, the Phoenix hydro-electric power plant was established. This is now controlled by the Pacific Gas & Electric Co., operating a number of public utility enterprises in California, which also controls the ditch.

In 1922, the Pacific Gas & Electric Co. applied to the State Railroad Commission for an increase in rates charged water-users. The commission, excluding earnings of the Phoenix power plant, approved water rates representing an increase of 100 per cent. The county, several municipalities and various water-users as individuals and as an association, carried the case to the State Supreme Court, which affirmed the action of the Railroad Commission. The U. S. Supreme Court found no reason for federal interference with this decision, which stands.

The joint engineering board, composed of American and Canadian engineers who are studying the St. Lawrence project, is meeting in informal sessions in Montreal this week. The object of the meeting is to correlate plans for the engineering investigations which will be conducted this summer on behalf of each country. Advertisements have been made in Detroit of the request for bids to do the boring which will be undertaken under the direction of the American members of the board.

New Pittsburgh to Easton Rail Line Proposed

The New York, Pittsburgh & Chicago Railway Co. has applied to the Interstate Commerce Commission for authority to build a 283-mile line across the state of Pennsylvania from Pittsburgh to Easton, with two branches in the Pittsburgh district, making a total of 344 miles. The company is a new one headed by Henry O. Evans of Pittsburgh, and is reported to have purchased the property and rights of the Keystone Air Line, a railroad organized in 1906 for the purpose of building a line from New York through Pittsburgh to Chicago. Its plans for the new line were filed with the Pennsylvania Public Service Commission last January, but no action was taken pending action on the company's application to the Interstate Commerce Commission.

Col. F. A. Molitor, of New York, is engineer for the new railroad company. No details are available other than those which came out at Washington when the application was filed.

Substructure Contract Let for Mississippi River Bridge

Contract for the substructure of the new Mississippi River bridge of the Atchison, Topeka & Santa Fe Ry., at Fort Madison, Iowa, has been awarded to the Union Bridge & Construction Co., Kansas City, Mo. Letting of the contract for the superstructure to the American Bridge Co. was announced in *Engineering News-Record*, April 9, 1925, p. 620.

Julius Kruttschnitt to Retire as Chairman of Southern Pacific

The directors of the Southern Pacific Co. have announced that Julius Kruttschnitt, the engineer who has served as chairman of the executive committee of the railroad since 1913, is to retire from active service on May 31.

Mr. Kruttschnitt was born at New Orleans, July 30, 1854, graduated from Washington & Lee University as a civil engineer in 1873 and taught school until 1878, when he joined Morgan's Louisiana & Texas Road and Steamship Co. as engineer of extensions and rose in its service to the various grades of roadmaster, assistant chief engineer, chief engineer and superintendent. In 1885 he became assistant manager of the Atlantic System of the Southern Pacific Co., and four years later was promoted to be manager. In 1895 he was made general manager of the entire Southern Pacific Co., and in 1898 was also made its fourth vice-president. In April, 1904, Mr. Kruttschnitt was made director of maintenance and operation of the Harriman System, including both the Southern Pacific and the Union Pacific, which position he held until the two systems were separated and he was appointed chairman of the executive committee of the Southern Pacific.

Plans for Sacandaga Reservoir Approach Final Stage

Special Correspondence

Work on the $9,000,000 Sacandaga reservoir on the upper Hudson River, under the supervision of the Hudson River Regulating District, is in a fair way to be started in the near future. Preliminary plans and specifications, prepared some time ago, were approved by the Water Control Commission of the state of New York on March 6, 1924, and presented at a public hearing on April 9 of the same year. Following the hearing, on May 7, 1924, the board made a determination that the public welfare required the proposed reservoir and a final order was issued on May 12. Subsequent to this action, the River Regulating Board, under the provisions of the conservation act providing for the construction of such reservoirs, made an apportionment of the cost among the benefited corporations, land owners, and communities, and submitted their findings to the Water Control Commission for its approval on Jan. 30, 1925. This approval was given on Feb. 13 and the date for the final hearing has been set as April 17, 1925.

The cost of the reservoir, estimated at $9,000,000, is to be paid in a large part by the companies developing power along the Hudson River below the reservoir. The largest contributors will be the Adirondack Power & Light Corporation, the International Paper Co., the Union Bag & Paper Corporation, Finch, Pruyn and Co. of Glens Falls, N. Y., and the West Virginia Pulp & Paper Co.

If, after the hearing of April 17, the final determination is in favor of the project, bonds will be issued to cover the cost and the interest charges, and the cost of retiring the bonds will be levied against the benefited parties.

Kansas Court Cannot Enforce Compulsory Arbitration

The Supreme Court of the United States in reviewing a decision of the Kansas Supreme Court reversed the decision of the Kansas Court which had upheld the Kansas Court of Industrial Relations by granting a writ of mandamus to compel the Charles Wolff Packing Co. to put into effect an order regarding wages and hours of labor in the company's slaughtering and packing plant. In rendering the decision, Justice Van Devanter said: "The system of compulsory arbitration, which the act establishes, is intended to compel, and, if sustained, will compel, the owner and employees to continue the business on terms which are not of their making. It will constrain them not merely to respect the terms if they continue the business, but will constrain them to continue the business on those terms.

"Such a system infringes the liberty of contract and rights of property guaranteed by the due process of law clause of the 14th Amendment: 'The established doctrine is that this liberty may not be interfered with under the guise of protecting the public interests by legislative action which is arbitrary or without reasonable relation to some purpose within the competency of the state to effect.' "

Plans for Building Montreal Bridge Progress

Plans for the construction of a bridge over the St. Lawrence River at Montreal are advancing. A report on best location of the bridge was made recently by the Montreal Harbor Commission's board of advisory engineers, which recommended a line extending from the junction of Delorimier Ave. with Craig and Notre Dame Sts., Montreal, southeasterly over the west end of Ile Ronde and over the east end of St. Helen's Island, to a point on the south shore about halfway between Longueuil and St. Lambert. The report of the board (T. W. Harvie, G. H. Duggan, H. A. Terrault, H. M. Mackay, and E. I. Vallee) was approved by the commission and the recommended line adopted. Subsequently, according to Paul Leclaire, chief engineer of the commission, it was decided that the bridge should be built in two consecutive sections, work to begin on the section lying between the south shore and St. Helen's Island. Bids on the substructure will be called for in April.

Governor Signs New Charter Bill for Westchester County

The new charter for Westchester County, adjoining New York City, drafted by Westchester County Government Commission, has been approved by Governor Smith after passage by the legislature and will go to popular vote in November. It provides for a board of supervisors with legislative powers only, a chief executive known as county president, a vice-president and a county fiscal agent, and a board of estimate and apportionment, to take office Jan. 1, 1928.

Waldo and Murray to Advise on Muscle Shoals

Under the provisions of the national defense act, which authorizes the employment of experts and others needed in connection with the Muscle Shoals development, the President has appointed W. G. Waldo as the commission's technologist and W. E. Murray to be secretary of the commission. Mr. Waldo is a civil engineer, a graduate of the Massachusetts Institute of Technology, who has been associated with the project since its inception, as engineer for the Tennessee River Improvement Association. During the war Mr. Waldo was in the service of the Ordinance Department. He was district supervisor for the Muscle Shoals district.

Three Engineers to Investigate Sewage Disposal at Detroit

The special commission to report on sewage collection, treatment and disposal for the city of Detroit, appointed some weeks ago by Mayor John W. Smith, has chosen a board of engineers to take up the subject. The three engineers are: Harrison P. Eddy, of Metcalf & Eddy, Boston, Mass.; John H. Gregory, professor of civil and sanitary engineering, Johns Hopkins University, Baltimore, Md.; Clarence W. Hubbell, consulting engineer and formerly city engineer of Detroit who made an extensive study of the disposal of Detroit sewage some years ago. The commission under which these engineers are to work consists of A. C. Marshall, chairman, George R. Cook, Francis C. McMath, Harry Fellows and Louis C. Rogers.

Subway Plans for Detroit

The Detroit city council has passed a resolution instructing the city Rapid Transit Commission to submit immediately plans for a subway system within the limits of Detroit, abandoning the lines proposed for the adjacent municipalities including Springwells, Highland Park and Hamtramck.

The commission suggested such action after difficulties had been encountered in getting the necessary legislative action at the state capitol, at Lansing, to permit the commencement of work on a complete system that would extend into the neighboring municipalities. The commission sought legislation that would permit the other municipalities concerned to participate in a subway system for Greater Detroit.

The council has the right under the present Home Rule Act to proceed with construction work within the city limits and the new plans asked for will cover subways included within this scope.

St. Louis Speeds Up Bond Issues

The charter of St. Louis, Mo., was amended by popular vote on April 7 to permit the letting of contracts for municipal improvements before the bonds authorized for the purpose have been sold. It is expected that this will speed up work under the $87,000,000 of bond issues authorized earlier.

Orleans Board Would Remove Levee on Mississippi

A formal application has been filed with the Corps of Engineers by the Orleans Levee Board asking permission to remove a line of levees on the east bank of the Mississippi just below Point a la Hache. The Mississippi River Commission has recommended that the request be granted.

While Army engineers do not expect to see any appreciable lowering of flood levels at New Orleans as a result of this improvised spillway, they are much interested in watching the effects of this experiment. It is expected to furnish useful indications as to what may be expected were a spillway put in at a point higher up the river.

Legislation providing for a study by the Corps of Engineers of spillway possibilities was lost after having passed both houses when the senators from Mississippi threatened to resort to the filibuster if necessary to halt the bill. They took the ground that this study might pave the way for the discharge of silt bearing waters into Mississippi Sound. Water from the Mississippi discharged at Point a la Hache, however, would not affect the coastal waters of Mississippi.

Oregon Appeals to Commission for New Railroad

In a recent hearing before the Interstate Commerce Commission representatives of the state of Oregon repeated their plea for the construction of over 300 miles of railway in south-central Oregon. The projected lines were described in *Engineering News-Record* Oct. 16, 1924, p. 635 and Jan. 15, 1925 p. 104. The Oregon Public Service Commission contends that the new lines are badly needed and that the Interstate Commerce Commission has authority to require their construction. On the other hand, attorneys for the railroad claim that the construction of the lines would be costly, that the traffic to be obtained would not warrant their construction, and that the Union Pacific, which would have to bear the brunt of the work, is not in a position to undertake such extensive construction.

At the same time this hearing was in progress an application was filed with the Interstate Commerce Commission by the Oregon, California & Eastern Railroad Co. for authority to construct two lines totaling 140 miles in the southern part of the territory in question. The proposed lines of the O., C. & E. R.R. do not appear to be included in the new lines requested by the state of Oregon.

Four Major Traffic Ways Advised for Kansas City, Mo.

The City Plan Commission of Kansas City, Mo., has recommended to the Board of Public Works that four main traffic ways be provided in that city, largely by widening existing streets to 80 ft. or 100 ft. One of the four improvements would be six and one-eighth miles in length.

Pan-American Road Conference Postponed Until Fall

The Pan-American Highway Conference which was to have opened in Buenos Aires May 22, will be held instead in October. Oct. 3-13 are the new dates fixed. The postponement was made necessary because of the inability of several of the countries to be ready to participate this spring.

The personnel of the commission which will represent the United States has been announced at the White House as follows: J. Walter Drake, Assistant Secretary of Commerce, Chairman; Charles M. Babcock, Commissioner of Highways for Minnesota; F. L. Bishop, Dean of the School of Engineering University of Pittsburgh; Thomas H. MacDonald, Chief of the Bureau of Public Roads; Frank Page, Chairman of the State Highway Commission of North Carolina; Dr. G. A. Sherwell, Secy. of the United States Section of the Inter-American High Commission; Representative William E. Hull, of Illinois.

An appropriation of $15,000 for the expenses of the delegates was allowed in the bill authorizing their appointment.

Keystone Company Wins Suit for Philadelphia Subway Contract

By a two to one decision of Common Pleas Court No. 1 in Philadelphia, given on April 8, the opinion handed down on March 31 by Judge McDevitt was reversed and the taxpayer's suit to prevent award of the contract for a portion of the Broad St. subway to the Keystone State Construction Co., at a contract price $113,000 in excess of that of the low bidder, was dismissed. Counsel for the taxpayer and the low bidder immediately took an appeal to the Supreme Court. The Supreme Court hearing was fixed for April 15 but no decision has yet been rendered.

The suit was based upon the theory that the low bidder should be awarded the contract even though a certified check covering $300,000 possible force account work was not included with the certified check covering the main items, which totalled in excess of $16,000,000.

The judges of Common Pleas Court filed three opinions in rendering their decision. Judge McDevitt held to his original opinion that the bond had been a substantial compliance with the law and the contract should be awarded to the low bidder. Judge Bartlett maintained that the letter of the law must be strictly adhered to. He declared that the director of the department had no power to accept the supplementary check and that the bid must be rejected. Judge Taulane concurred with Judge Bartlett in the opinion that the director has no discretion in the matter and that the contract cannot be awarded to the Brooklyn syndicate, but he pointed out that because of the substantial loss to the city involved in the award to the Keystone company, it is a "question of consideration" if all bids should not be rejected.

Previous features over the contest for the award of the subway work will be found in *Engineering News-Record* March 26, p. 537 and April 2, p. 573.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Cincinnati, Ohio, April 21-24, 1925.

AMERICAN WELDING SOCIETY, New York City; Annual Meeting, New York City, April 22-24, 1925.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Convention, Chicago, May 12-14, 1925.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Union College, Schenectady, N. Y., June 17-20, 1925.

Personal Notes

LIEUT COL. CLARENCE O. SHERRILL, chief military aid to the President and director of the new office of public buildings and public parks, at Washington, D. C., has been relieved of the duties as chief military aid to the President in order that he may devote all his time to the work of the new office. He is also executive officer of the Arlington Memorial Bridge Commission.

COL. SHERWOOD CHENEY, of the U. S. Army Engineer Corps, and at present commandant of the Engineer School at Fort Humphreys, Va., has been appointed chief military aid to the President, succeeding Lieut. Col. C. O. Sherrill. Col. Cheney, a graduate of the U. S. Military Academy and the Army War College, has spent his entire military life in the Corps of Engineers. He served in the Spanish-American War, and after the World War was a temporary brigadier general for a year. He holds the distinguished service medal and the croix de guerre with palms.

CHARLES S. FOREMAN, chief engineer and superintendent of the Kansas City, Mo., water department, has tendered his resignation effective May 1, to become associated with Smith Bros., Inc., of Dallas, Texas, which firm constructed the Missouri Valley and Turkey Creek tunnels of the new water-works supply system of Kansas City. Mr. Foreman entered the service of Kansas City in its water department in 1901 as a draftsman, and has advanced to the head of the department.

PAUL A. VOLCKER, for the past nine years city engineer at Lebanon, Pa., has been appointed city manager of Cape May, N. J., the first town in New Jersey to adopt the city manager plan. Mr. Volcker was formerly with the New York State Highway Commission.

WALTER V. BUCK, of Topeka, Kan., former assistant state highway engineer of Kansas, has been appointed state highway engineer succeeding Capt. L. R. Tillotson. For the past two years Mr. Buck has been a field engineer for the Portland Cement Association, his service as assistant state highway engineer being from 1919 to 1922. Prior to that he had been assistant city engineer at Manhattan, and at Junction City, Kan.

Obituary

CHARLES A. HEXAMER, secretary and treasurer of the Philadelphia Fire Underwriters' Association, and a member of the Fire Council of Underwriters' Laboratories, died at his home in Philadelphia March 9 at the age of 73 years. Mr. Hexamer graduated from New York University as a civil engineer in 1871. For some years he engaged in railroad engineering, in the map and survey publishing business and in insurance, then became secretary of the Philadelphia Board of Fire Underwriters and later of the Philadelphia Fire Underwriters' Association. He was vice-president for four years and seven times president of the National Fire Protection Association. He was also chairman of the Committee of Consulting Engineers of the National Board of Fire Underwriters for a number of years and a member of the board of managers of Franklin Institute.

PROFESSOR CHARLES W. LAWRENCE, head of the engineering department of the University of Southern California, died April 1 at his home in Los Angeles, aged 53 years. Professor Lawrence was born in Lawrence County, Pennsylvania. He graduated in civil engineering from Pennsylvania State College and acted as engineering instructor there for two years, then was professor of civil engineering at James Milliken University from 1906 until 1909, when he went to the University of Southern California.

CAPT. ALVA H. PERKINS, of the Corps of Engineers, recently serving at Boston, died in that city April 8. Captain Perkins was a graduate of Harvard University, and had served at Camp Grant, Fort Humphreys, Camp Custer and Fort Sam Houston. During the World War he was with the Engineer Reserves, took part in the Meuse-Argonne offensive and other engagements, and won the croix de guerre.

FRANK V. E. BAIDOL, contracting engineer, Buffalo, N. Y., died there April 10, aged 56 years. He was interested in paving, transportation and ferry enterprises in Buffalo and Canada. He was a civil engineering graduate of Cornell University. He was formerly for some years chief engineer of the Bureau of Engineering at Buffalo.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Water-Works Manufacturers to Exhibit at Convention

In addition to the list published in this journal April 2, p. 576, the following have applied for exhibit space at the American Water Works convention to be held April 27-May 2 at Louisville.

National Meter Co.
Canadian Engineers.
National Water Main Cleaning Co.
American Cast Iron Pipe Co.
Giant Manufacturing Co.
Gamon Meter Co.
Wailes Dove-Hermiston Corp.
The Pitometer Co.
Pittsburgh Testing Laboratory.
Sullivan Machinery Co.
Hays Manufacturing Co.
De Lavel Steam Turbine Co.
Edward E. Johnson, Inc.
Layne & Bowler Co.
The Central Foundry Co.
Electro Bleaching Gas Co.
Multiplex Manufacturing Co.
E. I. DuPont de Nemours & Co.
Roberts Filter Manufacturing Co.
East Jersey Pipe Co.
Van Gilder Water Meter Co.
F. B. Leopold Co. Inc.
Ford Meter Box Co.
Badger Meter Mfg. Co.
Pittsburgh Des Moines Steel Co.
Pittsburgh Meter Co.
Federal Meter Co.
International Filter Co.
Lead-Hydro-Tite Co.

Concrete Road Yardage

For March the yardages included in concrete pavement contract awards were, according to reports to the Portland Cement Association: 5,771,821 for roads; 2,575,741 for streets; and 154,318 for alleys; or a total for the month of 8,501,880 sq.yd.

The accompanying table summarizes the statistics available to date.

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1925

Month	Roads	Streets	Alleys	Total All Classes
Jan.....	3,474,421	963,256	75,236	4,512,913
Feb.....	3,787,192	1,201,224	58,723	5,047,139
March..	5,771,821	2,575,741	154,318	8,501,880
Total.	13,033,434	4,740,221	288,277	18,061,932

Business Notes

LEIGH I. HOLDREDGE, for several years district sales manager for Wallace & Tiernan in charge of their Philadelphia office, has joined the sales force of the Paradon Engineering Co., Long Island City, N. Y., manufacturer of chlorinators. Mr. Holdredge will have charge of sales in the New England states and in the states of New York and New Jersey.

CHICAGO BRIDGE & IRON WORKS, through its New York office, has secured the contract for furnishing all of the steel tankage in connection with the construction of the 300-mile pipe line for the Andian National Corporation, Ltd., Colombia. The contract includes furnishing the tankage for the terminal station at Cartagena on the Caribbean Sea, together with the pumping station storage at the intermediate terminals on the Magdalena River. The pipe line will reach the producing properties of the International Petroleum Co. and will have a daily capacity of 25,000 bbl. Approximately 4,000 tons of plate work are involved. This is the largest export contract of this nature which has been let in some time.

L. C. BULLINGTON, formerly assistant manager, power department, Westinghouse Electric and Manufacturing Co., at East Pittsburgh has been appointed manager of the Cincinnati district office of the company, succeeding the late James A. Brett.

GIBB WELDING MACHINES CO. (successor to Gibb Instrument Co.), Bay City, Mich., manufacturer of electric welding equipment, announces the appointment of Welding Service & Sales Co., Donovan Building, Detroit, T. M. Butler, manager, as agent in the Detroit territory for its line of arc, spot and seam welding machines.

Equipment and Materials

Austin Has New Trencher

The latest addition to the trench excavator line of the Austin Machinery Corporation, Muskegon, Mich, is the model No. 42-15 trench machine, which digs 15 ft. deep and 42 in. wide.

This improved excavator has a rugged frame which is heavier than supplied heretofore. The speed reduction and machinery reverse gears are housed and operate in an oil bath. A long belt drive is used to transmit power between the reverse gear unit and main machinery. A three-speed transmission with gears operating in oil provides three forward feed speeds for digging by shifting a lever and one reverse speed to care for the backfeed operation. The soil conveyor is reversible. Time for complete reverse is about one minute. The conveyor belt is 30 in. wide and is operated by a continuous chain drive. The control of the belt is by independent lever and the direction of travel can be changed instantly.

Power is supplied by a 6½x8 Twin City engine developing 60 hp. or a 7½x9 engine developing 75 hp.

Changes In Pipe Line Ditcher

The Barber-Greene Co., Aurora, Ill., announces changes in the design of its pipe line ditcher. Originally made to dig a trench 5 ft. 6 in. deep and 9 or 18 in. wide, the redesigned trencher will dig an 18-in. trench 7 ft. deep. The other features such as the vertical

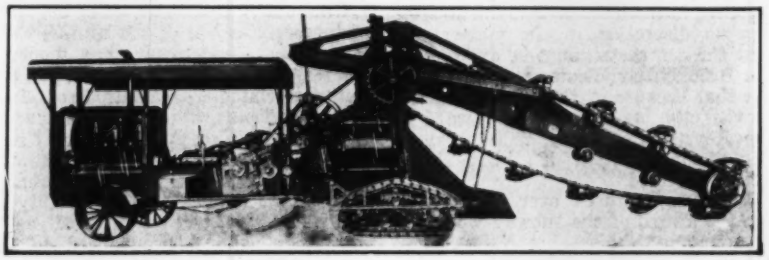
boom, the discharge conveyor which can be quickly set by means of a hand crank to discharge practically any distance from the trench on either side, and the compact crawler mounting have been retained. The crawlers, however, have been lengthened to 68 in. and have been widened to 14 in. This gives a bearing pressure of about 8 lb. per sq.in. on the crawlers.

Screen for Sewage and Industrial Wastes Embodies New Features

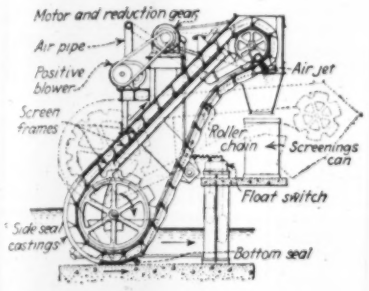
New features have been incorporated in the screen for sewage and industrial wastes known as the Jennings-Stein screen, manufactured by C. A. Jennings, Chicago, Ill. The screen is of the band type, composed of a series of articulated screen frames carried by roller chains running on tracks and passing over upper and lower sprocket wheels, the tracks and sprockets being supported on side trusses.

The important new feature is the use of the portion of the screen passing over the lower sprocket as effective screening surface, which eliminates the necessity for pits or depressions in the channel and enables the flow to continue straight through the screen without change in direction of channel.

Each screen section is provided with



a horizontal apron along its lower edge, lapping over a curved wearing surface on the following section so as to close any passage between adjacent screen sections at all times. The screen is cleaned by air jets from a pipe within

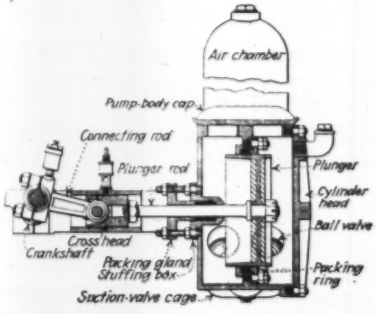


the periphery of the upper sprocket. The entire screen, with motor drive and blower, is self-contained and mounted on trunnions so that it can be tilted up for inspection and repair. Details are shown in the accompanying drawing.

The screen can be used either as a fine screen for the partial or complete treatment of sewage, or as a preliminary screen to remove coarse solid and floating matter prior to treatment in grit chambers, tanks, or by the activated-sludge process. As a fine screen a 10 to 20-mesh screen of bronze or monel metal is used, while as a coarse screen a ½-in. mesh of heavy gage galvanized wire is employed. Other sizes can be furnished if required.

Double-Acting Trench Force Pump

For use under conditions where the regular diaphragm pump cannot be employed the Domestic Engine & Pump Co., Shippensburg, Pa., has manufactured a double-acting, trench force pump. To cite an example the new



unit may be used when the discharge must be pumped to a considerable height above the pump causing a pressure in the discharge line which could cause frequent rupture of a rubber diaphragm. Instead of the diaphragm a solid bronze plunger reciprocates in the pump cylinder which is packed by ordinary hydraulic packing.

The construction of the pump, allowing the direct flow of material across the lower end of the pump cylinder, makes possible the handling of water containing a very large percentage of sand or other foreign matter without danger of this material "building up" in the pump chamber.

Two different units are offered. One has the pump directly geared to a single-cylinder 4-hp. engine. This unit has a displacement capacity of 105 gal. per minute. The other unit has a 5 to 8 hp. two-cylinder engine unit directly geared to the pump so as to give a pumping displacement of 150 gal. per minute.

Accurate Proportioning Device for Water Treatment Chemicals

International Filter Co., Chicago, has perfected the so-called International Head Chamber, the applications of which are manifold, but which is principally used for the proportioning of chemicals in water-softening or filtration plants.

The head chamber is illustrated herewith in its simplest form. It consists of a diaphragm mechanism *A* actuated by venturi, a lever *B* connected to the diaphragm plate and also to a parabolic float *C* riding in a float chamber

D of similar design, as well as to a plug valve *E* as shown, an operating float *F* riding in a cylindrical float chamber *G*, the cylindrical float chamber having an open connection *H* with the parabolic float chamber *D*. The plug valve riser *I* has a constant water supply connection *J* and a drain connection *K*. The head chamber may be connected to any venturi tube.

The differential pressure from the venturi is received by the diaphragm in chamber *A*, and is immediately transmitted by lever *B* to plug valve *E*, which it shuts. The water then rises in both float chambers *G* and *D* equally, and when the water in chamber *D* rises to a sufficient height, the buoyancy of float *C* causes plug valve *E* to open. This point is where the differential pressure is balanced by the buoyancy of the float for a certain elevation of water in chamber *D*. This establishes equilibrium as long as the flow of water through the venturi tube is constant. The operating float *F* is then at a certain height above its zero position corresponding to the flow of water through the venturi tube. The rod fixed to float *F* is connected to whatever mechanical device it is desired to operate in proportion to the flow.

When the flow of water changes, the differential changes as the square of the variation in flow. The design of the parabolic float is such that its buoyancy is proportional to the square of the height of water in the float chamber, thus automatically extracting the square root of the differential pressure and transmitting to the operating float *F* a movement in direct proportion to the flow of water through the venturi.

The only consumption of power for the device is hydraulic—that is, the constant water supply, for which there is required a maximum of only 25 gal. per hour.

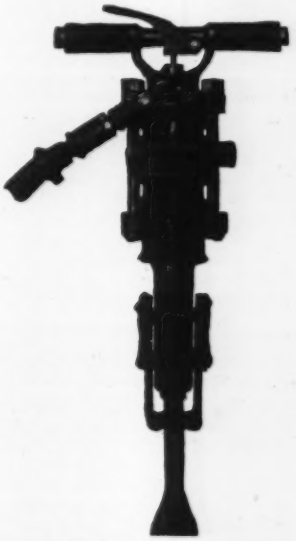
Industrial Engine of 10-Hp. Maximum Capacity

A comparatively small industrial engine having the desirable characteristics of a four-cylinder engine has been placed on the market by the Universal Motor Co., Oshkosh, Wis. The "Flexi-four," so called because of its steady, flexible performance, was designed and built with the idea of making it particularly adaptable to industrial uses, and provision has been made to provide various equipment, such as different types of bases, radiator and fan-cooling system, disk clutch and reduction drive which adapts the engine to practically any kind of industrial work coming within its capacity. Equipment which it may drive includes: concrete mixers, road-finishing machines, centrifugal pumps, pressure pumps, hoists, back fillers, etc., and machinery requiring not more than 10 hp.

Standard equipment consists of Bosch magneto ignition, built in, flyball type self-oiling governor, Zenith carburetor, muffler, and flywheel.

Two New Types of Paving Breakers

Two new types of pneumatic paving breakers have recently been put on the market by the Cleveland Rock Drill Co., Cleveland, Ohio. Model 44CB is a light-



weight machine, weighing 48 lb., and is best suited to such work as trimming down the sidewalls of tunnels, trenches and like excavations. Model C4, weighing 64 lb., finds its greatest effective-

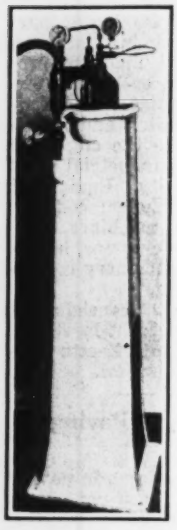
ness in tearing down old foundations or walls, in loosening frozen or gravelly ground, and in breaking up brick, stone, asphalt or any other pavement.

Each of the models is fitted with an automatic valve, through the high efficiency of which is obtained a powerful hammer blow and consequently rapid cutting. At the same time the air consumption and vibration are reduced to a minimum.

The hand grips are of large size, comfortably fitting the hand, and are made of soft rubber, tending to lessen the fatigue of the operator and consequently insure a bigger day's work.

Small-Capacity Chlorinator Has Thermostatic Control

A simplified, small-capacity chlorinator, designed particularly for small water-works and sewage plants or swimming pools, and known as the thermostatically-controlled Type T unit, has been developed by The Paradon Engineering Co., Long Island City, N. Y., for use under conditions where expert attendance is not generally obtainable and operating funds are limited.



The chlorinator consists of a white vitrified enamelled pedestal having a compartment which holds a small cylinder of chlorine, generally of about 12 lb. capacity. A silver control valve regulates the flow of chlorine from this cylinder. A volumetric type measuring meter, enclosed in a glass cylinder, indicates the amount of chlorine flowing. An injector operated by an auxiliary water supply draws the chlorine from the glass cylinder and carries it to the point of application. Part of the water flowing through the injector is bypassed and forms a water-jacket around the outside of the chlorine cylinder, keeping the latter at a constant temperature. The flow of chlorine, therefore, remains constant for any one setting of the silver control valve.

The advantages claimed for this machine are, first, that it is made out of material that will not corrode even in the presence of moist chlorine. Second, controlling the temperature of the chlorine cylinder by a water-jacket eliminates the necessity of a compensating reducing valve, lowering the cost of the apparatus and adding to its simplicity. Third, the chlorinator and chlorine cylinder are in one unit, self-contained and compact.

This apparatus will handle capacities up to approximately 2 lb. of chlorine per 24 hr. Water under a pressure of at least 20 lb. per square inch is necessary to operate the apparatus. This type chlorinator will take care of the swimming pool up to 100,000 gal. capacity, the average small sewage plant up to capacities of 50,000 gal. per 24 hr. and water supplies up to 100,000 gallons per 24 hr.

Pump Installations for Service and Standby Water Supply

The value of industrial gasoline engines as stand-by units in water-works plants is illustrated by the experience of the city of West Chicago, Ill. This city had two 12-in. wells, one serving a standpipe and the other a concrete reservoir. The job of installing sufficient pumping machinery to make the station entirely automatically operated was given to the American Well Works, Aurora, Ill. This was done by installing on one well an automatically operated turbine-driven unit, the other well being made a stand-by unit driven by a Novo 18-hp., model AF engine, manufactured by the Novo Engine Co., Lansing, Mich. If one pump goes down or if the power is off, water can be pumped from the other well. Two Domestic service driven pumps deliver water at the rate of 325 gal. per minute from the reservoir to the standpipe.

One unit only is used at a time and the other automatically cuts in if the pressure reaches a low level. The pumps can be reversed in their operation by a transfer switch. In conjunction with these two units there is a 1,000-gal. fire pump operated by both motor and gas engines. This pump will deliver water into the mains if the two service pumps are out and will also deliver water should the power be off.

It is reported that the station is in perfect running order and that all stand-by equipment can be started at a moment's notice.

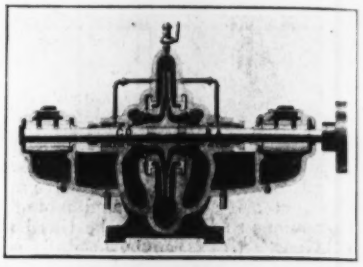
Guided Bucket-Boom for Trench Backfiller

An attachment of interest to water-works men who have charge of the installation of water lines is announced by the Parsons Co., Newton, Iowa. The attachment is for the Model 20 Backfiller and is called the Guided Bucket Boom. It consists of a 21-ft. boom with a guided scraper operating on the boom similar in action to a skimmer scoop. This attachment is used for backfilling trenches where the spoil bank lies between the trench and the backfiller. In order to backfill the spoil bank on the opposite side of the trench from the backfiller it is only necessary to reverse the position of the scraper on the carriage. Heretofore no backfiller has been designed to work on the spoil bank side of the trench.

Double-Suction Pump Designed to Neutralize End Thrust

A means of automatically neutralizing end thrust in double-suction centrifugal pumps has been developed by the Earle Gear & Machine Co., Philadelphia. End thrust or unbalanced pressure on the sides of the impeller springs form the impossibility of getting absolutely accurate castings for the pump casing or the impeller. Very small variations in the shape, smoothness or size of the casing or impeller water spaces, therefore, cause differences of pressure on the sides of the impeller.

The unbalanced end thrust is eliminated, it is claimed, in the Earle Type "B" DSV pump, because if the thrust is toward the reader's right the radial seat at *B* will tend to close, while the radial seat at *A* is opened, building up a pressure on the total area of the right side of the impeller. While this is occurring the radial seat at *C* has closed, and that at *D* has opened, placing a suction or reduced pressure on



the area of the side of the impeller from *C* to the shaft. Hence the area on the right side of the impeller subject to high pressure is greater than the area of the left side of the impeller from *C* to the shaft, the pump rotor will tend to move slightly to the left until it reaches a point at which the total pressure will be the same on both sides of the impeller, and true hydraulic balance is obtained. The opposite cycle of events takes place if the original thrust tends to be toward the reader's left.

Due to this hydraulic balance, no thrust bearing or collars are required, but since any device must ultimately wear out and being inside the case where wear is not visible, small fixed collars are placed on the shaft, set at a distance from the face of the bearing bushing, which will not become operative until the limit of allowable wear has occurred within the case, at which time the engagement of the collars and bearings becomes a visible indication of replacement of wearing parts within the pump.

Publications from the Construction Industry

Water Meters — PITTSBURGH METER CO., Pittsburgh, Pa., in the April number of the *Water-Works Journal*, a quarterly publication issued by the company, carries the reader through 24 pages of pictures and description of how water and gas meters are made. It gives a comprehensive idea of the care and precision taken in their manufacture.

Synchronous Motors for Pumping— ELECTRIC MACHINERY MANUFACTURING CO., Minneapolis, Minn., in a 16-p. bulletin, emphasizes the advantages of motor-driven centrifugal pumps over steam-driven pumps in municipal water-works service. Other uses are in deep well pumping, irrigation pumping, drainage pumping, dry dock pumping, sewage pumping, mine pumping and suction dredging.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Steel Demand Slowing Down

Despite the fact that the steel ingot output for the first quarter of this year was about 470,000 tons greater than that for the corresponding period last year, the present rate of mill operations is slightly under that obtaining in the first month of the first quarter of 1925.

STEEL INGOT OUTPUT—AM. I. & S. INST.

	1925 Tons	1924 Tons
January	4,180,413	3,633,639
February	3,740,004	3,809,185
March	4,180,333	4,187,942
First Quarter	12,100,750	11,630,766

Unfilled orders on books of the U. S. Steel Corporation, Mar. 31, 1925, were 421,207 tons under those on hand Feb. 28, 1925. This is the first drop in unfilled tonnage since July 31, 1924.

UNFILLED ORDERS ON BOOKS U. S. STEEL CORPORATION

1925 Tons		1924 Tons	
Jan. 31, 1925	5,037,323	Jan. 31, 1924	4,798,429
Feb. 28, 1925	5,284,771	Feb. 29, 1924	4,912,901
Mar. 31, 1925	4,863,564	Mar. 31, 1924	4,782,807

The drop in production is commensurate with the decrease in demand.

This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for waterworks and excavations, $25,000 for other public works, $40,000 for industrial and $150,000 for commercial buildings.

MONEY VALUE OF CONTRACTS LET—ENTIRE U. S.

Week Ending	Public Work	Private Work	Total Contracts
Apr. 16, 1925	**$10,778,000**	**$21,051,000**	**$31,829,000**
Apr. 9, 1925	20,896,000	27,522,000	48,418,000
Apr. 17, 1924	28,549,000	22,293,000	50,842,000
Heaviest Week Last Year			
May 8, 1924	26,370,000	38,829,000	65,199,000
This Year			
Apr. 2, 1925	43,603,000	27,633,000	71,236,000
Jan. 1 to Date			
1925	255,796,000	368,788,000	624,584,000
1924	254,104,000	351,412,000	605,516,000

Public Bond Sales Gained Heavily in March

March disposals aggregated $109,080,606 according to the *Commercial and Financial Chronicle*. This figure shows a large increase over the total for the previous month, which was $79,133,861 and also over the total for March 1924, which reached $100,331,302.

The bond sales during the first quarter of 1925 total $316,186,189 which is the largest first quarter total recorded.

The State of Pennsylvania led last month with an issue of $20,000,000 4's for highway work. Illinois placed $1,650,000 4's and Oregon $1,000,000 4½'s.

Chicago placed the largest municipal award—$6,825,000 4's. Other large placings follow: Cleveland City School District, $4,800,000 4½'s; Philadelphia School District, $3,000,000 4's; Milwaukee County, $2,670,000 5½'s.

The rates in the following table ranged from 4 to 6 per cent. Three placings were below par, two at par, the remainder called for a premium.

REPRESENTATIVE PUBLIC BOND SALES, MARCH, 1925

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Alabama	Harbor Impvt.	$900,000	4½	100.50	.....	.....	.....	Ward, Sterne & Co.
Idaho	Funding and Bldg. Impvt.	963,500	4½	100.63	4.18	April 1	1926-45	Childs Bond & Mortgage Co. and others
Illinois	Compensation	1,650,000	4	99.07	4.08	Aug. 1	1944	National City Co.
Pennsylvania	Highway	20,000,000	4	101.8078	3.8715	April 1	1930-52	National City Co. and others
County								
Adams, Ind	Road	5,200	4½	101.02	4.27	Mar. 15	1926-35	A. P. Flynn
Alcorn, Miss	Drainage	16,500	6	100.83	.....	May 1	1-20 yrs.	Bank of Ripley
Barry, Mo	Building	10,000	5½	100.87	5.49	May 1	1929-44	Little & Moore
Bailey, Tex	Court House	60,000	6	102.50	5.80	Feb. 1	1926-65	Geo. L. Simpson & Co.
Blue Earth, Minn	Road	15,825	4½	101.51	.....	Feb. 1	1935-43	Mankato Loan & Trust Co.
Benton, Ind	Highway	41,500	4½	101.20	4.06	Mar. 14	1926-30	J. F. Wild & Co.
Butler, Kan	Roads	150,000	4½	100.75	.....	Jan. 1	1926-45	Guarantee Title & Trust Co.
Carteret, N. C	Road and Bridge	75,000	5½	.....	.....	Mar. 1	1945-59	Ryan, Sutherland & Co.
Campbell, Ky	.....	200,000	5	106.33	4.50	May 1	1942-46	Weil, Roth & Irving Co.
Cuyahoga, O	Sewer	530,000	4½	100.95	4.35	April 1	1926-38	Otis & Co.
Cuyahoga, O	Road	159,443	5	102.69 103.35	4.43 4.40	Mar. 1	1926-35	Provident Savings Bank & Trust Co.
Columbia, N. Y	Highway & Co. Home	67,000	4½	106.232	4.06	Mar. 1	1925-47	Geo. Gibbons & Co.
Daviess, Ind	Road	28,000	4½	102	4.09	Mar. 15	1926-35	Meyer-Kiser Bank of Indianapolis
Freeborn, Minn	Highway	18,177	4½	101.65	4.11	Jan. 1	1936-45	Wells-Dickey Co.
Greene, Pa	Highway	800,000	4½	101.033	4.13	Mar. 1	1929-36	Citizens Nat. Bank
Henry, O	Road Impvt.	82,400	5	102.18	4.58	Mar. 1	1926-34	A. T. Bell & Co.
Hoke, N. C	Road and Bridge	20,000	5	102.73	4.79	Mar. 1	1935-54	Drake, Jones & Co.
Highland, O	Road Impvt.	11,300	5½	102.82	4.83	April 1	1926-33	Provident Savings Bank & Trust Co.
Howard, Ind	Roads	15,710	4½	101.39 101.78	4.23 4.12	Feb. 15	1926-35	J. F. Wild & Co. and others
Iredell, N. C	Road and Bridge	1,000,000	4½	101.169	4.69	April 1	1929-50	Guaranty Co. and others
Klamath, Ore	Roads	125,000	4½ & 4½	100.48	.....	April 1		Lumbermen's Trust Co.
Rock, Wis	Highway	175,000	5	106.36	.....	June 1	1936-37	Second Ward Securities Co.
Township								
Florence, N. J	Storm Sewers	17,000	5	101	4.80	April 1	1926-36	The First National Bank
Washington, Iowa	School Building	9,000	5	.....	.....	April 1	1928-35	Geo. M. Bechtel & Co.
Municipal								
Akron, O	Street Impvt. Grade Crossings	400,000 835,000	5 4½	103.836	4.37	April 1	1926-55	Harris & Oatis, Inc., and others
Amherst, N. Y	Boulevard	1,100,000	4½	103.151	4.20	Mar. 1	1927-55	Equitable Trust Co. and others
Ashland, Ky	Building	200,000	4½	102.50	4.37	June 1	1962-65	J. C. Mayer & Co.
Bayville, N. Y	Water System	122,500	4½	100.197	4.22	Mar. 1	1930-64	Oyster Bay Bank
Belle Plain, Kan	Improvement	6,500	4½	100	4½	Jan. 1	1926-35	State Auditor of Kan.
Burley, Ida	Water	24,000	5½	100	5½	Mar. 1	1945	Childs Bond & Mortgage Co.
Burlington, Iowa	Fire Station	4,900	4½	.....	.....	.....	.....	Hanna-Shreves Co.
Boise City, Ida	Station Approaches	115,000	4½	100.26	4.47	Feb. 1	1945	Palmer Bond & Mortgage Co.
Bessemer City, N. C	Sewer	20,000	5½	104.41	.....	Feb. 1	1928-47	Carolina Securities Co.
Cheektowaga, N. Y	Highway Sewer	41,600 43,000	4.4 4.4	100.20 100.86	4.37 4.30	Mar. 1	1926-45	Fidelity Trust Co.
Chicago, Ill	Street Impvt.	6,825,000	4	99.2191	4.10	Jan. 1	1927-44	National City Co.
Giddings, Tex	Water Works Sewer	46,000 45,000	6 6	107.50	5.43	Mar. 15	1926-65	J. T. Bowman
Jackson, Mich	Public Impvt.	524,500	4½	101.01	4.18	April 1	1926-54	Northern Trust Co. and others
Manatee, Fla	Sewer and Water	142,000	5½	102.06	.....	Feb. 2	1935-55	Braun, Bosworth & Co.
Miami, Fla	Public Impvt.	1,500,000	4½	99.299	4.58	Mar. 1	1926-55	Geo. H. Burr & Co. and others
Norwalk, O	Water Filtration	27,000 135,000	5 5	101.61	4.62	Mar. 1	1925-34	Huron Co. Bank
Pharr, Tex	Street Impvt. Water Works	20,000 25,000	6 6	105.30 101	4.47	Mar. 1 Jan. 20	1925-49 1927-65	Stranahan, Harris & Oatis, Inc. J. L. Arlitt of Austin

Weekly Construction Market

THE fact that contract letting (money value) from Jan. 1 to Apr. 16, inclusive, was 3 per cent ahead of the corresponding period last year, strengthens belief in the improbability of any notable rise or fall in cost of construction in the very near future.

The combined elements of construction cost, namely, labor and materials, point toward at least temporary stability.

This condition has evidently brought out a certain amount of construction that was being held back because of cost uncertainties.

Materials stocks at mills and warehouses are plentiful but not too heavy.

Production schedules are tending toward curtailment in order to prevent price declines which normally result from oversupply.

There are remarkably few wage disputes awaiting settlement at this time, especially in the building trades. Continuation of approximately the same wage schedules as are now in force, seems probable for at least the remainder of the current quarter.

A truce has been reached in the controversy which recently existed between bricklayers and plasterers in New York City. The trouble arose over alleged violation of jurisdictional rights and for a time seriously hindered about $22,000,000 worth of construction on various projects of the Thompson-Starrett Co.

An agreement has also been reached in the strike of steamfitters and helpers which recently occurred in Pittsburgh. The former gained an advance of 50c. per day from March 1 to Dec. 1, 1925, at which time an additional 50c. per day is to be granted. This contract will hold until March 1, 1927. Helpers received an advance of 20c. per day.

Of twenty-one cities reporting regularly to *Engineering News-Record*, only two, Cleveland and Denver, report any wage disputes pending. In the former, demands are being put forth by the glaziers and in the latter, by painters, carpenters, sheet-metal workers and electricians.

In Chicago, the wage schedule for marble setters, ornamental iron workers, carpenters and hoisting engineers has been increased to $1.37½ per hr., against the former rate of $1.25.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb.	4.50	4.45	4.75	3.50	3.75	4.65	5.00	+3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.40	3.38	3.00	3.25	3.87½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	53.2%	43%	56½%	54.25%	36%	44.7@55.5%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	52.60@53.60	56.00	+56.00	+46.76@48.20	55.50	62.00	55.00	55.00	60.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.30	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.75	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	35.00	56.00	29.00@39.00	39.75	34.75	27.00	25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.50@2.75	1.45	1.85	—1.21	1.35	2.70	1.60	2.80	—9.50
Common brick, delivered, 1,000	17.00	10.50	12.10	12.00	+13.50@13.60	12.00	15.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.0808	.0941	+.065	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.0808	.0941	+.065	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	1.09	1.17	—1.30	1.22	1.18	1.28	1.24	1.12	1.11
Common Labor									
Common labor, union, hour	.75	.30	.....	87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	30@.50	.75	.50@.55	.35@.50	.50	.50	.20@.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers, 75c.; excavating laborers, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 2, the next on May 7.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.93). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.